These pages constitute a SUPPLEMENT to the "GAS JOURNAL" INSTITUTION NUMBER, from which Newspaper Postage limits necessitated the exclusion of the last paper and discussion. In addition to these, we are now able to include various written contributions to the proceedings, and a series of remarkable views of London's Gas Lighting, which also had to yield to pressure on our columns last week. The Supplement form has been chosen for the convenience of readers who may prefer to bind these pages serially with the June 10 report.

SUPPLEMENT

GAS JOURNAL
June 17, 1931

The New Oswald Street Gas-Works of the Burnley Corporation

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Before commencing to describe the new Oswald Street Gas-Works, in the early days called Old Hall site, I think it would be advisable to explain to some extent the reasons which made it desirable for the erection of a new gas-works for the Burnley Corporation.

Prior to November, 1927, all the gas produced for the town's requirements in Burnley was made at the Parker Lane Works, where gas had been manufactured continuously from 1823. In 1912, the late Mr. J. P. Leather, M.Inst.C.E., M.Inst.Gas E., who was then the Gas Engineer to the Corporation, with excellent foresight and sound judgment, prevailed upon the Council to secure the option of purchase of land for the site of a new gas-works. This land occupied approximately 23½ acres, and was bounded on the west by the Lancashire and Yorkshire Railway (Manchester to Skipton line), and on the north by the Leeds and Liverpool Canal passing under the railway adjoining the land for a short distance. Mr. Leather, however, was not able to persuade the Council to purchase the land or to consider the erection of a new works prior to the war, to the consequent financial disadvantage of the town.

After the war it was increasingly imperative that money should be expended in the re-construction of the old works or the preparation of a new one, but it was not until 1920 that the Council could be induced to consider seriously the necessity for such expenditure.

In September, 1923, Mr. Leather submitted a preliminary layout of a proposed new gas-works, together with an approximate estimated cost, which he gave as £200,000.

For private reasons, in November, 1923, Mr. Leather relinquished his office as Engineer and Manager, but was engaged to complete the layout of the proposed new works and submit a report therewith before terminating his services with the Department on Jan. 31, 1924.

In the preparation of this report the author was closely concerned, as at that time he occupied the position of Deputy Engineer and Manager.

On the termination of Mr. Leather's services the Corporation submitted the report which he had presented to Mr. W. Doig Gibb, O.B.E., M.Inst.C.E., M.Inst.Gas E., to consider and report. With the exception of an alteration in the capacity of the installation and certain other minor alterations, Mr. Gibb commended the scheme to the Council for adoption. The author, in the meantime having been appointed Engineer and Manager, was instructed to prepare a detailed scheme and estimates on the lines laid down by his predecessor.

The Parker Lane Works occupied a site with an area of about 7 acres situated in the centre of the town. The site was very congested, and had no railway facilities. Nearly all the coal used on the works had to be brought by canal, and all outgoing materials had to be taken away by road transport.

The plant, which consisted of inclined and vertical retorts (both installations being the first of their kind beyond experimental plants), had a nominal capacity of 3 million c.ft. per day, which, when in full working order, produced only 2¾ million c.ft. per day, with carburetted water gas plant in duplicate of 750,000 c.ft. per day capacity.

The inclined retorts, although they had been working for 33 years, were in a very satisfactory condition from a gas-making point of view, and were more economical in costs of production than the remaining gas-producing plant. The conditions for the workmen were, however, very unsatisfactory. The verticals, carburetted water gas, and ancillary plants were in a more or less derelict condition. The works had been constructed in a piecemeal manner, and, probably due to the fact that the holder storage capacity was not sufficient to enable the works to be shut down, new plant was attached to other by unsatisfactory connections. For instance, the connection from the exhauster house to the washers was only 18 in. diameter, whilst the connections to the purifiers were 30 in. diameter.

Our maximum day's output in winter at that time was 4,350,000 c.ft., and as the old works had to continue to supply the town until the new works were constructed, it can be imagined with what anxiety and makeshift a satisfactory supply to the town was produced. In fact, during the last winter prior to the starting-up of the new works, the supply had to be augmented by the provision of a suction gas plant hastily erected in December and connected to the foul main at the inlet to the condensers, the calorific value being maintained, of course, by the use of gas oil in the carburetted water gas plant. Burnley adopted the Gas Regulation Act in 1921, and it was found very difficult to maintain regularly the declared calorific value.

It will be understood that the cost of production was very high, bearing in mind that at times as much as 36 per cent. of carburetted water gas had to be produced.

Below are given some works costs for wages during the years ended 1926 and 1927 per 1000 c.ft. of gas produced.

Wages Details for Two Years Ending 31st March, 1927.

PARKER LANE WORKS.

Coal carbonized	92,472 tons
Coal gas made	1,186,270,000 c.ft.
Make per ton (1000 c.ft.)	12·83
Coal gas wages	£26,821 18s. 1d.
Do. per 1000 c.ft.	5·42d.
C.W. gas made	704,968,000 c.ft.
Coke to generators	12,520 tons
Do. lbs. per 1000 c.ft.	39·78
Gas oil used	1,158,253 galls.
Do. gallons per 1000 c.ft.	1·64
C.W. gas wages	£6024 15s. 7½d.
Do. per 1000 c.ft. C.W.G. made	2·05d.
Total gas made	1,925,324,000 c.ft.
Total gas-making wages	£33,038 1s. 2¼d.
Do. per 1000 c.ft. mixed gas	4·12d.
Purifying wages	£1,274 4s. 7d.
Do. per 1000 c.ft.	0·15d.
Maintenance of works	£18,292 18s. 5d.
Do. per 1000 c.ft.	2·28d.
Coke wages	£5,441 14s. 8d.
Do. per 1000 c.ft	0·67d.

The maintenance of works expenditure was indeed very high, as very little repair work had been done during the war, in common with many other gas undertakings. The expenditure under this head was as follows:—

Wages and Materials.

Year.	—	Per 1000 C.Ft. Sold.
	£ s. d.	d.
1918–19	16,164 8 8	5·88
1919–20	22,966 18 3	7·44
1920–21	31,506 7 7	9·21
1921–22	33,180 10 3	9·61
1922–23	19,937 7 10	6·21
1923–24	19,479 16 10	5·74
1924–25	20,188 9 6	5·90

Upon the appointment of the author the Council desired to consider an alternative proposal of re-constructing the old works in order to postpone the erection of the new gas-works for a further period. The author prepared a scheme with an estimated cost of £79,000, which, however, he did not recommend, but advised the Council to proceed with the scheme which they had already resolved to adopt, and to make application to the Unemployment Grants Committee for assistance in the payment of interest on the additional capital to be expended on the grounds that they would be expediting the expenditure which could otherwise be delayed for a period of five years.

The detailed scheme was prepared by the author, and a revised estimate of £300,000 was made, which was accepted by the Ministry of Health after their inquiry, and a grant was made from the Unemployment Grants Committee of 50 per cent. of the interest on the various loans for a period of 15 years, or for the period of the loan whichever would be the shorter, upon the difference in cost between the estimated expenditure on a new site and the £79,000 which it was estimated would be the cost of renovating the old works.

In 1921 the Council, having purchased the Oswald Street site, agreed to the extreme necessity for the erection of a new gasholder of 3 million c.ft. capacity there. This was designed by Mr. Leather, and was in process of construction when he resigned from his office.

The author will not deal further with this holder except to mention that it is a five-lift column guided holder, in a concrete tank, and is 170 ft. high and 160 ft. in diameter. The tank cost £19,500, and the holder £84,500.

The Site of the New Works.

A brief description of the site of the scheme has been given, and at this stage the Council decided to purchase another 5½ acres of land near the entrance for any future purpose for which it might be required and to improve the shape of the site. Being on the outskirts of the town the land was comparatively cheap, costing approximately £850 per acre, the whole eventually comprising 29 acres.

The shape of the site is still peculiar, being rather lengthy and narrow at the southern end, where the entrance is situated. This is due to the fact that Burnley is a colliery town, and the coal had not been worked outside the boundaries of the land purchased. Towards the northern end a stream intersects the site, which, although of very little use for the provision of water supply, formed a valley which can be used for many years as a tip, this portion not being required for erection purposes for many years.

The contour of the site was rather undulating, and necessitated excavation at the southern end, and filling at the northern portion where the declivity commences to the stream. Boreholes were taken at various points prior to purchase, and it was found that the ground was very good geologically for the purpose of works construction. Trial holes were dug to a depth of 60 ft., and it was found that the site consisted chiefly of hard clay down to rock.

The site of the works, whilst conveniently situated for the economic production and supply of gas, was some 600 yards distant from the nearest intercepting sewer, which was the main outfall to the Duckpits Sewage Works from which a 12-in. diameter sewer, averaging 9 ft. deep, was laid on the site of a proposed arterial road. In addition, there was a length of 550 yards of 9-in. diameter sewer averaging 10 ft. deep laid inside the works.

A carriageway had to be laid across the fields from the end of the public thoroughfare in Oswald Street to the entrance gates, which carriageway is 21 ft. wide, with two 7 ft. 6 in. wide footpaths of tarmacadam, the carriageway being constructed of a centre of Trinidad asphalt with a strip of granite sett paving on either side for horse-drawn vehicles—all on reinforced concrete.

Although the preliminary work was constructed by the Gas Department, involving a large amount of filling and pitching, the finishing of this road was in the hands of the Borough Engineer, as it was adopted as a public street.

The works roadway was constructed with a carriageway 20 ft. wide, a portion of which is sett paved in granite, and the remainder and secondary roads surfaced with tarmacadam, with a footpath 5 ft. wide on one side only.

Foundations.

In view of the satisfactory nature of the subsoil, most of the foundations were constructed in mass concrete; in certain cases reinforced concrete was employed.

The Unemployment Grants Committee intimated that the buildings must be constructed in concrete, and in order to avoid the usual uninteresting appearance of a large area of plain concrete, the larger buildings were designed in structural steelwork with concrete pilasters and panels, but the filling to the panels was provided with precast reinforced concrete slabs with rebated joints in courses, while the pilasters and string courses were cast *in situ*.

The laboratory, messroom, and calorimeter house were constructed in concrete blocks with artificial stone finish, with cavity walls. All the buildings were roofed with asbestos sheeting, the larger buildings with Trafford tiles, while the temporary end of the retort house left for further extension was sheeted with protected metal on angle framework. In subsequent extensions for No. 2 portion of the works, protected metal sheets coated with aluminium have been adopted, as being more permanent and reliable.

Portland cement was used for all concrete work, and bulk work consisted of 5 parts of coarse, hard, broken grit stone, 2 parts of sand to 1 of cement; and for the reinforced work 4 parts of similar stone through ¾ in. and above ¼ in. to 2 of sand and 1 of cement. All the concrete was machine mixed.

Some constructional costs are given later, but the author wishes to say that each building of any size was let by separate contract at varying times over a period of 18 months, and the prices per cubic yard for bulk concrete varied between 45s. and 32s. 6d.

Sidings and Coal Stores.

On reference to Diagram 1, it will be observed that the general level of the London, Midland, and Scottish Railway above the works is about 23 ft. 6 in. Advantage was therefore taken in design to use this level for the automatic descent of coal and oil. Storage sidings were provided on the east side of the works, running towards the northern end, two railroads being laid to accommodate 64 wagons, with provision for a further two roads when extensions are necessary. 87,000 tons of filling, which was principally shale and rock obtained from a neighbouring colliery dump, was used for these sidings. The construction of a bridge was necessary to accommodate a footpath which it was required to maintain between the sidings and the works proper. Wagons are shunted in and out of these sidings by the Railway Company.

The northern end of these sidings is close to the boundary which adjoins the Leeds and Liverpool Canal, from which service can be obtained if and when desired.

The wagons are hauled from these sidings by the works locomotive to a series constructed in the south-eastern portion of the site on ground filled from the excavation of the large gasholder tank.

Two roads are laid here, from which wagons are drawn as required for emptying by an electrically-driven capstan erected at a position approximately midway along the length of the coal stores. The capstan is driven by a 20-H.P. motor; the diameter of the large drum is 2 ft. 8 in. and the small drum 1 ft. 7 in. The capstan is reversible. Two loose head bollards, 12 in. in diameter, are also provided for working in conjunction with the same.

Adjacent to the breaker pit there are fitted two sets of hydraulically-operated wagon tippers of the end tipping type. Each ram is 12 in. in diameter, and has a stroke of 8 ft. 9 in., thus raising a 12-ton coal wagon to an angle of 45°. The wagon tippers are driven by an electrically-driven hydraulic pump which supplies water under a pressure of 250 lbs., and each tipper is provided with its own control valve.

Gas oil tanks are placed on the road adjoining the storage tanks, into which the oil is run by gravity, and from there by gravity to the carburetted water gas machinery house and the naphthalene washer.

From these sidings a ramp is constructed with a gradient of 1 in 25 to the natural level of the works.

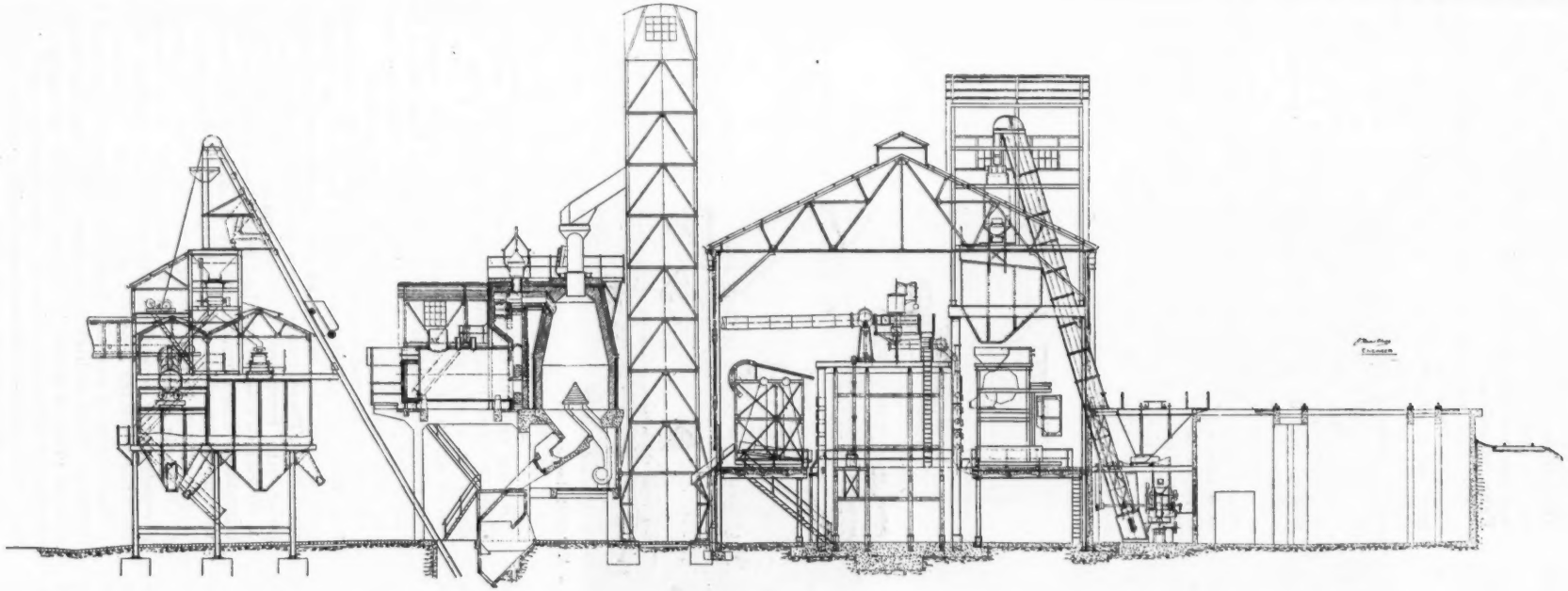


DIAGRAM 1.—SECTION OF COAL STORES, RETORT HOUSE, SULZER PLANT, AND COKE STORAGE PLANT.

COAL STORE AND RETORT HOUSE.

Diagram 1 also gives particulars of this structure and the foundations.

The coal store dimensions are 195 ft. 3 in. in length by 65 ft. wide, and 23 ft. 6 in. deep, and it is divided into eight bays by cross walls. In the north end (bays No. 7 and 8) of the coal stores is constructed the coal crusher and elevator feed building, which communicates with the clinkering floor of the retort house, which is also at yard level.

This building is 25 ft. long by 17 ft. 3 in. wide, and is surmounted by the coal receiving hopper. This hopper is 19 ft. 6 in. in length and 13 ft. in width, having a capacity of 30 tons, and is provided for receiving the coal as tipped from the wagons. It is covered with a grid for the prevention of accidents to workmen and machinery.

The coal stores are open at the top except for an open ended roof 26 ft. 3 in. high to the eaves from the rail level, erected over bays 8 and 9, where the coal tipping takes place.

The whole of the stores is constructed in reinforced concrete with three railroads longitudinally laid, with a 3 ft. walking space alongside each road. A 9 ft. by 7 ft. doorway is formed in each partition wall at ground level and in line for intercommunication from one end of the coal store to the other.

It is customary to run the works from incoming coal, but on the rare occasions on which coal is required to be moved from stock, the steam-driven rail crane and grab is used for the purpose. The grab has a capacity of 55 c.ft. and the crane can handle coal from any portion of the stores, and deposit under the previously-mentioned roof into the receiving hopper. The total capacity of the coal stores is approximately 7000 tons, the bays varying in size between 650 tons and 1000 tons capacity.

The floor of the coal stores and clinkering floor was finished with a 1 in. granolithic topping, and treated with silicate of soda.

RETORT HOUSE BUILDING.

This building is 207 ft. long in 18 spans of 65 ft. 4 in. in width, at 11 ft. 6 in. centres, which coincides with the centres of the buckstays of the retort settings. The height of this building is 51 ft. 8 in. to the eaves, and 68 ft. 8 in. to the ridge. The chimney is constructed at the north end, independent of the building, and in brick, and is 90 ft. in height—just sufficiently high to meet with the local bye-laws.

As a general description of the type of building adopted has been given, the author will not enlarge further, as Diagram 1 gives some details, and an excellent idea of the type can be obtained from the photograph.

CARBONIZING PLANT.

The type of carbonizing plant selected was horizontal after very full and careful consideration. The merits of

horizontal and vertical retorts, continuous and intermittent, have been so clearly and adequately detailed to you by their respective advocates that it is not advisable to enter upon the subject except to say that local considerations finally decided the type selected. The disadvantages which can be attributed to horizontal retorts are:—

(1) Large occupation of land space per ton of coal carbonized;
(2) The production of dirt and steam;
(3) The production of naphthalene.

In the case under review No. 1 was not a great disadvantage as there was plenty of room and land was not very expensive; also the adoption of a Sulzer plant removed any objectionable steam from quenching, and the slight production of smoke in charging is of no serious consequence. The removal of naphthalene is effectively remedied by a rotary brush washer, and the use of gas oil at a very low cost.

It was considered desirable to produce a gas of at least 475 B.Th.U. in quality, and the production of water gas was considered to be more profitably done in a separate plant.

The bench consists of 14 settings of 10 retorts set at 11 ft. 6 in. centres. The retorts are 24 in. wide by 18 in. high " D " section, by 22 ft. in length, and each bed is set in two rows of 5 tiers. The bench is constructed on a mass concrete foundation 3 ft. 6 in. in depth, and the total height of the bench from the clinkering floor level is 29 ft. 4 in.

The actual depth of the regenerator is 9 ft. 6 in., although the distance from the clinkering floor to stage level is 13 ft.

After full consideration of the merits of silica retorts it was decided to install seven settings of high-grade fireclay and the remainder of silicious retorts. These retorts were installed for comparative purposes, and to date there is no difference to be observed between them, either in the results produced or their condition.

The type of setting chosen was that of Drakes, Ltd., and equipped with their tubular regenerators. The setting being rather wider than standard practice, the furnace is of large capacity, and contains a generous grate area. The step grate was adopted. The furnace does not require clinkering, but is pricked up every four hours, and the ashpan emptied once per shift.

Fireclay bricks of the same make as the retorts and Meltham silica bricks were mainly used in the construction of the settings, and the exterior walls and top of the setting and the furnace walls were insulated with Moler bricks.

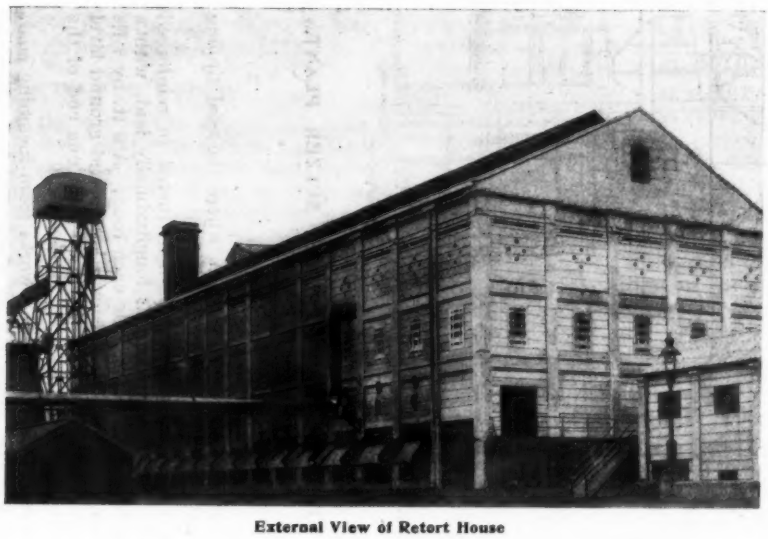
The charging floor is 22 ft. 10 in. wide, and the discharging floor 18 ft. 6 in.

The main flue runs under the centre of the bench, at the end of which is placed at the stage floor level, a multitubular waste-heat boiler erected on staging across and over the main flue. The capacity of this boiler is 9500 to 10,000 lbs. of steam per hour from and at 212° Fahr. The fan is arranged to maintain a steady pull of 0·5 in. in the main flue. The heating surface is 4560 sq. ft., and the working pressure 200 lbs. per sq. in. with 185° Fahr. superheat.

The coal elevator consists of a completely cased-in structure from the coal floor level to the elevator head, and has a length of 73 ft. 2¾ in. between centres. The elevator is capable of raising 40 tons of coal at a speed not exceeding 100 ft. a minute. The buckets are of malleable cast-iron, 20 in. long, arranged at 18 in. pitch.

A Lea cubimeter has been fitted between the elevator and the conveyor for the measurement of a fluctuating flow of coal up to a maximum of 40 tons per hour, and is driven from the top shaft of the elevator.

The coal conveyor is of the push plate type, capable of dealing with 40 tons of coal per hour and travelling at a speed of 100 ft. per minute. The conveyor is constructed with 167 ft. centres, the carrying trough being of cast-iron and arranged with a track flange on each side for the push plate wheels. Special spring ball oil cups are provided for the lubrication of each runner wheel.



External View of Retort House

A coal crusher is installed, but is actually used very little, a large proportion of the coal used being dank, slack, or single nuts, which are by-passed from the screen on to an arrangement of local design, consisting of a circular turntable with fixed plough from which the coal is fed into the elevator boot. This avoids any hanging up of wet slacks, either in the shoot or boot.

A set of 14 coal bunkers arranged in one continuous line down the retort house and in front of the bench is provided for the supply of coal to the retort charging machine. These bunkers are constructed of ¼ in. steel plate with hoppered bottoms, each having a capacity of 36 tons of coal when filled from the conveyor, without trimming. Each bunker has two 10 in. by 12 in. openings with doors provided with striking gear for the automatic supply of coal to the stoking machine. The coal storage is of ample capacity for 48 hours, and it is therefore necessary only to elevate coal during one shift on three days per week for a period of the year.

The charging machine is of the projector type, and is combined with a discharging ram. The machine is capable of filling a retort if desired, and will discharge and charge 6 retorts in 9 minutes. The machine will handle dank with a high moisture content with complete success.

On the discharging side the hot coke is conveyed from the retort by a Gibson-Nicholl machine, details of which have been described in an earlier paper to this Institution. This machine travels along the retort house and

places in the path of the retort a tube slightly larger than the retort in section. The hot coke simply slides along the tube without any tumultuous motion, and thence through openings in the wall of the retort house. The tube, which is capable of being elevated at an angle longitudinally with the retorts, is used for feeding the furnaces, each of which will take the contents of one tube filling. The coke is raked back into the furnace by the use of a ram which is attached to the machine. The furnace lid is also removed by the same machine.

per shift on the whole of this installation. His duties include the cleaning of the top of the retort bench, and the attention to the waste-heat boiler. The stand pipes are of course fitted with the necessary liquor supply pipes and nozzles, pressure being given by liquor pumps in duplicate erected in the retort house basement.

The liquor overflow pipes from the seal pot from the base of the scrubber standpipe are led to a cast iron closed top tar settling tank provided with baffle plates of 8400 gallons capacity, placed in the retort house base-

Interior View of Retort House, showing Congdon Standpipes.

The retort mouthpieces are fitted with patent self-sealing type of lid, and project 1 ft. 7 in. on the charging side and 1 ft. 5 in. on the discharging side.

Congdon System.

The gas is removed from the retorts by Congdon pipes situated on the charging side of the retort house. Two scrubber standpipes are erected to each bed of retorts, there being no gas offtake pipes on the discharging side of the bench. This installation is very similar to the one erected at Stretford and described by Mr. W. M. Carr, M.Inst.Gas E., in his paper before the Institution of Gas Engineers in 1925. Under this patent each retort has its own offtake, and its own control valve, which is spherical in shape, and automatically cleans itself

ment adjoining the liquor pumps. The tar overflow main, which is 6 in. in diameter, from this tank, is taken to the underground tar storage well, and on its route collects the tar and liquor from other seal pots in the retort house and from the condensers.

When the author decided to install the Congdon pipes he felt that he would be fortunate if he did not experience some trouble, and was a little apprehensive regarding the possible cracking of the uptakes. However, such fears have not been realized in the slightest, and, fortunately, up to date no repairs have been necessary. The saving in labour and cleanliness in the retort house is unquestionable, and improved thermal yield has undoubtedly resulted, but to what extent has not been ascertained. Some data on this installation, given in tabular form, may be of interest.

Ammoniacal Liquor Samples from Oswald Street Gas-Works.

Source of Sample.	Temp. °Fahr.	Free Ammonia.		Fixed Ammonia.		Total Ammonia.		Ammonium Thiocyanate. Grms. per 100 C.cs.
		As Grms. per 100 C.cs.	As Oz. Strength.	As Grms. per 100 C.cs.	As Oz. Strength.	As Grms. per 100 C.cs.	As Oz. Strength.	
Congdon tank (pump to sprays)	155	0·44	2·03	1·63	7·5	2·07	9·5	0·81
Congdon tank (return from sprays)	170	0·35	1·61	1·70	7·8	2·05	9·4	0·77
Condensers	..	1·79	8·26	0·08	0·4	1·87	8·7	0·05
Livesey	..	4·34	20·02	0·12	0·6	4·46	20·6	0·19
Rotary scrubber	..	3·70	17·06	0·07	0·3	3·77	17·4	0·15
Well	..	1·66	7·66	0·50	2·3	2·16	10·0	0·30

in its seating. Upon opening out after a lengthy run the pipes were found to be very clean except that pieces of carbon had deposited behind the valve which tended to restrict its movement in opening. In order to effect rapid cleaning the bolt in the top left-hand of the inspection door has been removed, and replaced with a stud, through which the debris can be easily removed by a bar when the occasion requires.

The liquor seal and tar collection pots are placed under each standpipe, and situated with their tops at the charging stage level. These are regularly cleaned out by the Congdon attendant, one attendant only being engaged

The gas collecting main, into which the 28 scrubber standpipes discharge their gas, is 18 in. diameter of circular steel flanged pipe, which runs the full length of the retort bench. It is provided with three 18 in. branches, and two section isolating valves. Three 14 in. diameter retort house bell governors are attached to the 18 in. branches, and discharge into a 24 in. diameter condensing main, which runs practically the full length of the bench and across the yard overhead to the water cooled condensers.

It has often been said that fireclay retorts of the dimensions employed will carbonize 17 to 18 cwt. of coal in

12 hours. In Burnley it has been found, however, that 14½ to 15 cwt. per charge is as much as can be properly carbonized in that period with the regular combustion chamber temperature of 1375° C. Some allowance must be made for the fact that the Burnley coals, particularly the Mountain Mine and Top Bed seams, and especially in the form of dank with from 6 to 10 per cent. of moisture, require longer distillation than many coals. It is also necessary that the black ends of charges should be avoided where a Sulzer plant is in operation, to avoid combustible gas being in circulation in the coolers, so a short section of the tail-end of the spent charge is used in the place of a stopper when inserting a new charge of coal.

The coke is discharged into a steel lath skip placed in position outside the opening in the retort house wall provided for each setting. When the skip contains the hot coke from 5 or 6 retorts it is propelled by a steam accumulator locomotive to the base of the hoist shown in the photograph. The skip is picked up from its carriage, and hoisted to the correct level, tipped into either of the two Sulzer plants at will, and descends again to its carriage, the whole movement being controlled automatically after the operator in the base has set the machinery in operation. As this plant was described at length in the author's paper before the Manchester District Institution of Gas Engineers in December, 1928, he will not enlarge upon this description, but briefly explain that each plant is capable of dealing with 75 tons of hot coke when working at maximum steam efficiency, or of cooling 120 tons of coke per day with a corresponding reduction in efficiency. The plant will produce an average of 840 lbs. of steam from and at 212° Fahr. per ton of coke.

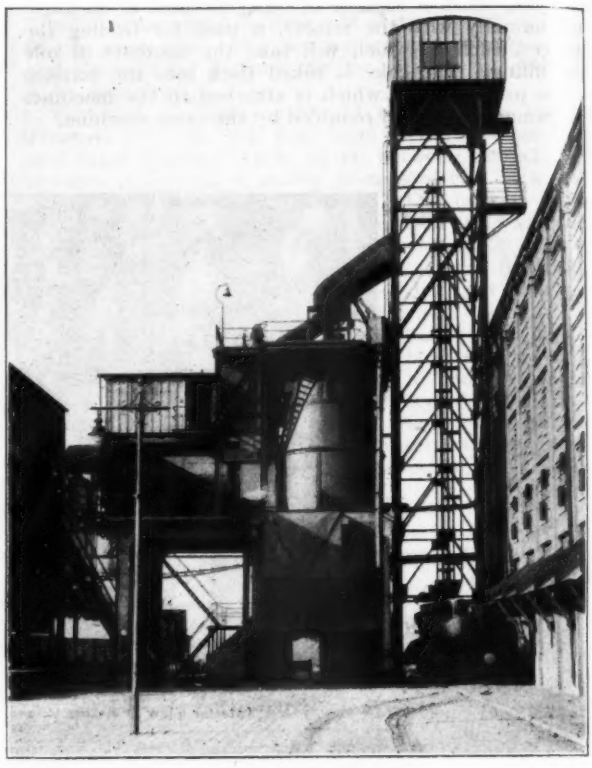
A Mono Recorder is fixed to indicate the contents of the circulating gases, and to convey prompt warning of any leakage resulting in the production of hydrogen and carbon monoxide.

The plant is adequately fitted with explosion doors, but fortunately they have appeared to be unnecessary since the early days of starting up the plant.

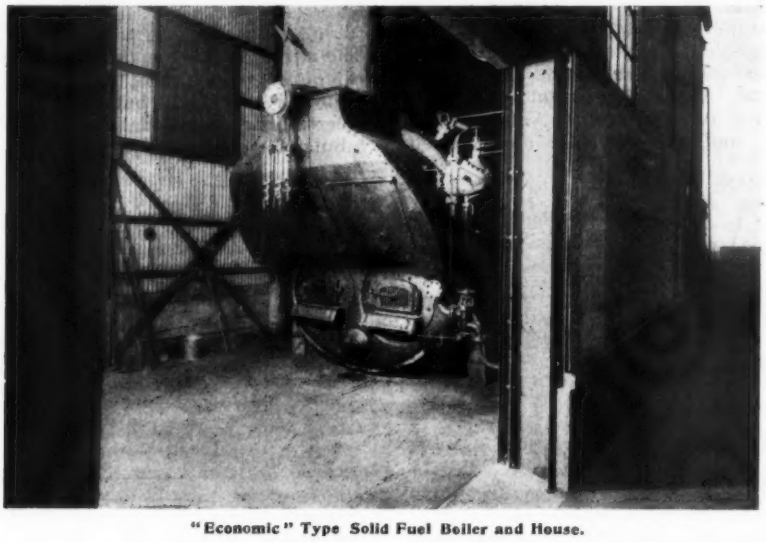
The heat from the hot coke placed in the plant is used for the generation of steam at 200 lbs. pressure per sq. in. with 185° Fahr. of superheat, by two boilers, one attached to each plant, each capable of evaporating 5000 lbs. of water from and at 212° Fahr.

As the charge of coke is deposited in the cooler, a corresponding quantity is withdrawn from the outlet into the subsidiary bunker which is emptied automatically by an inclined skip hoist, which raises 1 ton per load and is set to work or stopped by push button controls. After tipping, the coke descends over a jigging screen of a type fitted with horizontal bars with short fingers, and set on an incline plane. The screenings descend through a by-pass to one of two rotary plate screens, each set over four subsidiary bunkers for the collection of domestic, medium, and small nuts, the first bunker containing dust screenings up to ⅜ in. in size. The bulk coke passes through or by a coke crusher as required direct to a canvas rubber belt conveyor of the shuttle type for storage in any of the six bunkers, each of a capacity 61 tons, equalling 3 days' maximum production.

Bagging stages are provided in the whole of the bunkers



Sulzer Plant and Fireless Loco.



"Economic" Type Solid Fuel Boiler and House.

Since the above paper was contributed, the satisfactory results recorded therein have been fully maintained.

The coke produced is very popular, and is uniform in size and in pieces of about 3 in. to 3½ in. An average analysis is as follows:—

	Per Cent.
Moisture	0·10
Volatile matter	0·80
Ash	7·5
Fixed carbon	91·6
Calorific value	13,640 B.Th.U. per lb.

with loading bays for road vehicles. Coke of all sizes can also be filled into rail trucks.

The one solid-fuel boiler which the Works possesses is laid down in a central position on the Works close to the coke bunkers, and the coke dust is handled by the crane and grab and placed into the feeding bunker for this particular boiler. The remaining fine breeze is sold to electricity undertakings and for concrete block making. No difficulty is experienced in its disposal.

Condensers.

Two 3 million cubic feet per day vertical water tube condensers were installed to deal with the coal gas produced. The area of air cooling surface is 808·5 sq. ft., and the area of water cooling surface 7550 sq. ft. In use these condensers were found to be inadequate to deal with the volume of gas produced at the rated capacity, and for some reason it is considered that the Congdon scrubber standpipes are in some measure accountable. Two additional condensers of the same type have since been erected of a smaller capacity.

Power House.

This building also adjoins the water gas house. The interior is artistically decorated and the walls are tiled to a height of 13 ft. The floor is finished with terrazo. In the main portion are installed two four-blade Waller exhausters, each with a capacity of 150,000 c.ft. per hour at about 68 r.p.m. against a pressure difference of 42 in. head of water with a steam pressure of about 100 lbs. per sq. in. The engines are fitted with variable expansion gear, and steam consumption on a full load is 970 lbs. per hour each.

It may be said that although steam at 200 lbs. pressure is generated and used throughout the remainder of the Works, the exhausters and the chemical works steam main is governed down to 100 lbs. pressure.

Two air blowers of a capacity of 4500 ft. of air per hour each are driven from the above exhausters, and the air mains taken direct to the purifiers, into each of which air can be admitted at will.

Two electric generating sets, each driven by an Ashworth & Parker two-crank compound engine with a speed of 400 r.p.m. and steam pressure at 180 lbs. per sq. in. with 185° Fahr. superheat. These engines drive two Mather & Platt open type compound wound interpole generators, each capable of developing 100 kw. at 440 v. D.C. at 400 r.p.m. Each generator is fitted with static balancers for dealing with 25 per cent. out of balance current for lighting, &c. The generators on full test gave 92·8 per cent. efficiency. The sets when on test closely approximated the maker's guarantee, and on full load have a steam consumption of 31·31 lbs. per kw. hour.

The switchboard consists of two generator panels and five distributor panels, each fitted with watt hour meters. Three pole circuit breakers with no volt and reverse features are fitted to the generator panels, and double pole breakers with no volt and overload release are fitted to all distributor circuits of 100 amps. and over. The board is built up on the usual steel frame, the panels being of polished slate, and the fittings of " oxy-bronze " finish to resist atmospheric corrosion. All connections are at the back of the board.

This room also accommodates the usual gauges, recorders, attendants' recording calorimeters for manufacturing purposes, and foundations are laid for a third exhauster and electric generator.

Under the exhauster house is a lofty basement approached from the inside by a wide easy iron staircase. In this basement oil and engine stores are kept, and there all mains, connections, cables, drains, &c., are visible and accessible.

The site of the works is laid out for three complete units, each of 3 million c.ft. per day capacity with subsidiary plant to the inlet of the holder, the only connecting points being at the inlet to the exhausters for the purpose of expediency, and arrangements are made for the water gas to be admitted at this point to any of the three streams when completed.

One complete works unit has been laid down, which is the subject of this description, and later reference may be made to the installation of the major portion of the subsidiary plant for a second unit.

In this room is also installed a central pyrometer indicator of the Electroflo type, on which is indicated the temperatures of coal and water gases, water and steam at various points required; also the temperatures affecting the waste-heat boiler, the Sulzer, and water gas waste heat boilers. The Sulzer and water-gas plants are fitted with their own Electroflo indicators, and the central system acts not only as a check on the subsidiary indicators, but also on the accuracy of the records made by the plant attendants.

The second portion of the power house, which is partly divided by a partition wall, contains all the water gas machinery, comprising one turbo and one electric blower, oil pumps, water circulating pumps, and boiler feed pump, and a 90,000 c.ft. per hour " Connersville " meter. The water gas comes direct from the relief holder to this meter, and is conveyed by a main laid accessibly in a covered trench to the inlet to the exhausters.

Both C.W.G. blowers are of the duplex Travers & Clark type, with two impellors on the same shaft, one for the generator blast, and one for the secondary or tertiary blast.

Economy of power results from this arrangement, and one undoubted advantage in operation is that the air to the generator can be set at a fixed amount irrespective of the use of secondary blast.

The steam turbo blower is controlled by a Drayton regulator, which reduces the speed of the machine when the water gas plant is on the " run." The turbine is connected to the fan through a Garrard friction gear.

The electric blower is used to start up the water gas plant, and after the water gas self-steaming boiler has begun to generate, the turbo blower is used in its place.

In this room is also fixed an electrically driven geared pump to operate a vacuum system for the self emptying of all the works syphons. A vacuum pump and air and water separator for the return water of the exhauster heating system is also fixed here, by which the condensate is returned to the hot feed tank situated over this portion of the power house.

All the exhaust steam from the engines, pumps, and turbine is collected together in this room at a pressure of 3 lbs. per sq. in., and after oil separation is utilized for the heating of the water from the hot feed tank, and for the artificial heating of all the works buildings where necessary.

Wet Purification Plant.

The mixed gas proceeds up No. 1 stream through a Livesey washer and two washer scrubbers of the rotary brush type arranged in line at the edge of the tar and liquor wells. Short tar and liquor connections are required here, and economy of ground space results. Subsequent extensions run in parallel lines over the wells. The water admitted into No. 2 washer produces the liquor which is fed into No. 1 washer, which subsequently passes through the Livesey washer to the wells.

Tar and Liquor Wells.

These are constructed in reinforced concrete. The liquor well is 80 ft. long by 30 ft. wide; the tar well 40 ft. long by 30 ft. wide, the whole being about 18 ft. deep.

At the outlet of the washer scrubbers is fixed a steam heating arrangement of local design for pre-heating the gas to the purifiers. This has now become standard practice in most gas-works.

Purifiers.

The purifiers are six in number laid practically on the natural ground level, but the tops of the boxes reach the revivifying floor and yard level. One side and both ends are enclosed, and on the other side is a trench which contains the connections.

These purifiers are depicted in the photograph, and are designed to standard practice with rubber sealed lids. They run in one continuous length of 210 ft., are 35 ft.

wide by 6 ft. deep, and are filled with two layers of oxide on flat grids, each about 1 ft. 10 in. in depth.

The purifiers are controlled by single valves of the Western type, this type of valve being adopted throughout the works, and fitted with grease gun lubrication. The purifier valves, however, were designed on the lines of a water gas plant valve for quick operation for rotating purposes.

The first two boxes are worked singly or in series for " cleaning up purposes; " the remaining four are rotating boxes, backward rotation being made daily.

In the design of the purifiers, as in the major portion of the works, simplicity was the keynote, and it was felt that expensive equipment and mechanical handling was unnecessary in a plant which had so rarely to be disturbed. For emptying and filling, the lid-lifting crane was utilized to support two conveyors fitted with canvas rubber belts and hung by chain blocks which enable them to be reversed for either emptying or filling. The conveyors are chain-driven from a small motor attached to the end of the crane, the motor being supplied by flexible cable from conveniently placed plugs.

When emptying, the oxide is dropped direct from the conveyor to a breaker of 15 tons per hour nominal capacity, which aerates and disperses the oxide on to the revivifying floor under the shed. Unless the purifiers are being filled with new oxide direct from railway trucks, it is found more simple and convenient to fill them by barrow.

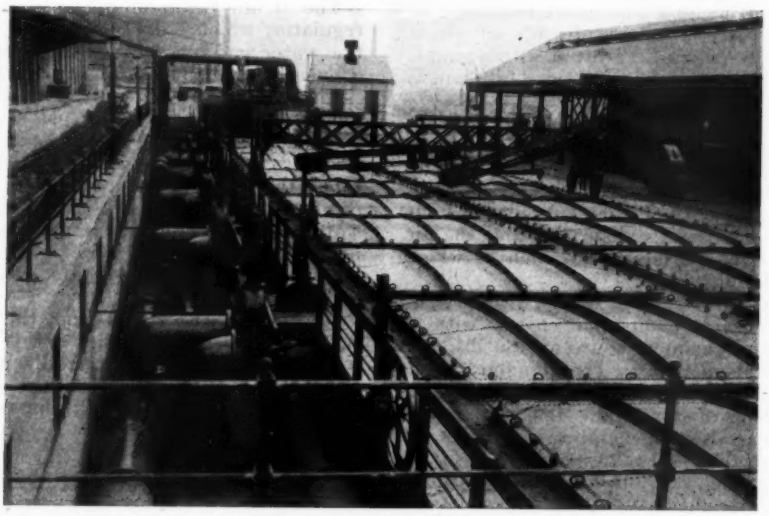
Steam pipes are provided to each purifier for the moistening of the oxide, which tends to become dry.

The gas inlets are arranged at the connection side of the boxes between the two layers of oxide, and the outlet, also at the side of the box, is a common duct from top and bottom. Each box contains about 80 tons of oxide.

At the end of the purifiers is arranged a naphthalene washer which consists of two vessels of the rotary brush type with a total of eight chambers, and is used continuously. The oil is replaced in the circulating tanks every two days. Gas oil is used for this purpose, the oil being returned by the circulating pump attached to the washer to one of the large storage tanks, from which it runs to and is used in the water gas plant. The quantity of gas oil used is about 23 gallons per million c.ft., the naphthalene content at the inlet to the washer containing about 12 grains per 100 c.ft.

Adjoining the washer, enclosed in a small house erected on a stage floor, is a 150,000 c.ft. per hour " Connersville " meter.

Up to the outlet of the station meter all the connections are 24 in. in diameter, and are laid overhead where possible. From this point the main to the holder is 30 in. in diameter.



View of No. 1 Set Purifiers.

Carburetted Water Gas.

The C.W.G. plant house is a commodious building attached to the power house.

The operating stage is left open to the basement where possible for ventilation and light purposes, and communication from this floor is possible to a room containing the hot water feed tank over the power house, C.W.G. machinery section. There is, however, no opening to make it possible for dirt or fumes to enter the power house, and all the high-class machinery is entirely under the control of the power house attendant.

The No. 1 water gas plant installed is of the Travers & Clark patent, the only plant of its type to be erected owing to the death of Mr. Clark before its completion. Messrs. Davison & Partner kindly completed and started up the plant on behalf of the remaining Director of the firm.

The plant is substantial, and generously constructed, and is capable of producing blue water gas to a quantity of not less than 750,000 c.ft. per 24 hours, or lightly carburetted water gas 775,000 c.ft., or 500 B.Th.U. gas 800,000 c.ft. per day. Any run can be either blue or carburetted at will, without loss of time for changing over. There are no hot valves, all the valves being on cool gas with consequent reduction in size and maintenance. The stack valves are of light weight and close by springs, and are therefore unusually tight. The levers, which are of the Westinghouse brake type, are grouped together for quick operation, and the manual labour required on the plant is therefore considerably lessened.

Mention has previously been made of the separate primary and secondary air supplies.

In order to produce the variable demands made of the plant the superheater is increased in capacity from the usual standard, but the carburettor, which is a separate vessel, although lined with firebrick is completely without chequer brickwork, the oil being injected at high pressure is finely atomized.

The oil sprayer can be lifted out of the hot zone or easily removed for making blue water gas.

The generator is 8 ft. 9 in. in diameter, and arranged for a working depth of fuel bed up to 8 ft.; but there is nothing in the design of this vessel requiring special mention except that the outlets are exceptionally large to produce the minimum of back-pressure and facilitate repairs.

Above the superheater section is arranged a high temperature combustion chamber for converting the heat energy entering the waste-heat boiler into sensible heat. The design ensures that all blast gases shall pass through the combustion chamber, and although blue water gas may pass through it, the carburetted gas does not.

The waste heat boiler is of the vertical fire tube type

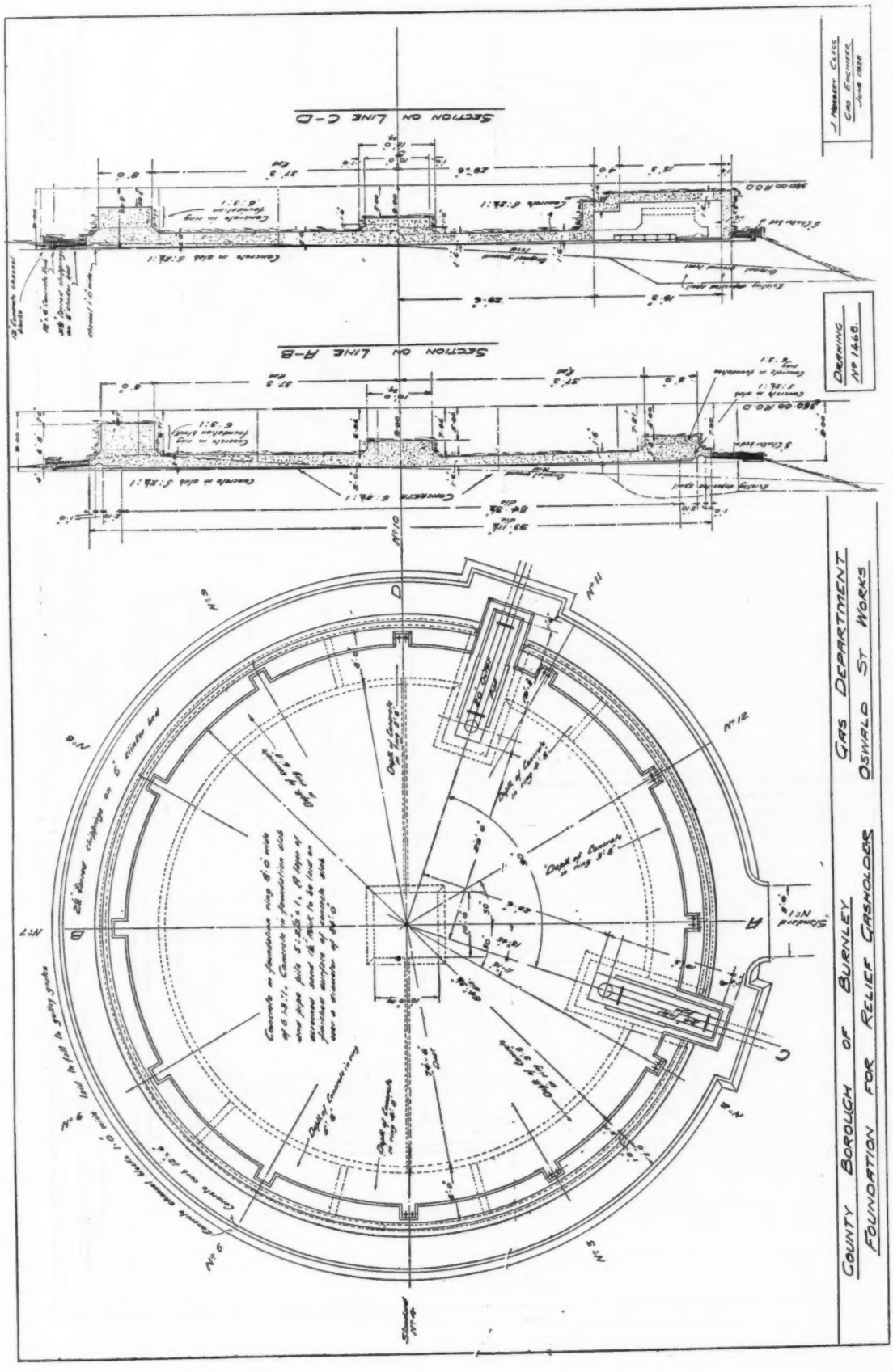
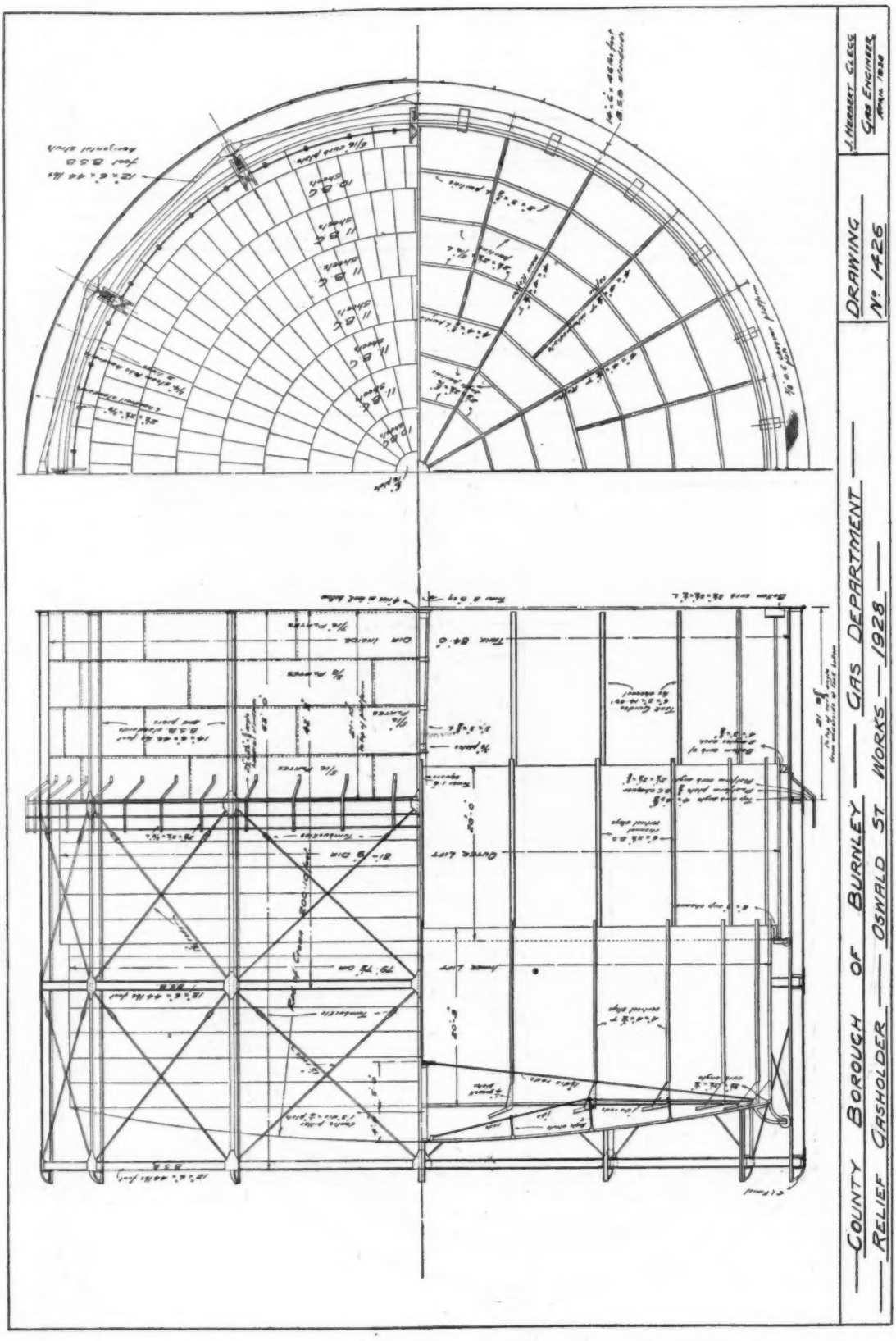


DIAGRAM 2.—FOUNDATIONS OF C.W.G. RELIEF HOLDER.


J. HERBERT CLEGG
GAS ENGINEER
BURNLEY
DRAWING
No 1426
COUNTY BOROUGH OF BURNLEY — GAS DEPARTMENT —
RELIEF GASHOLDER — OSWALD ST WORKS — 1928 —

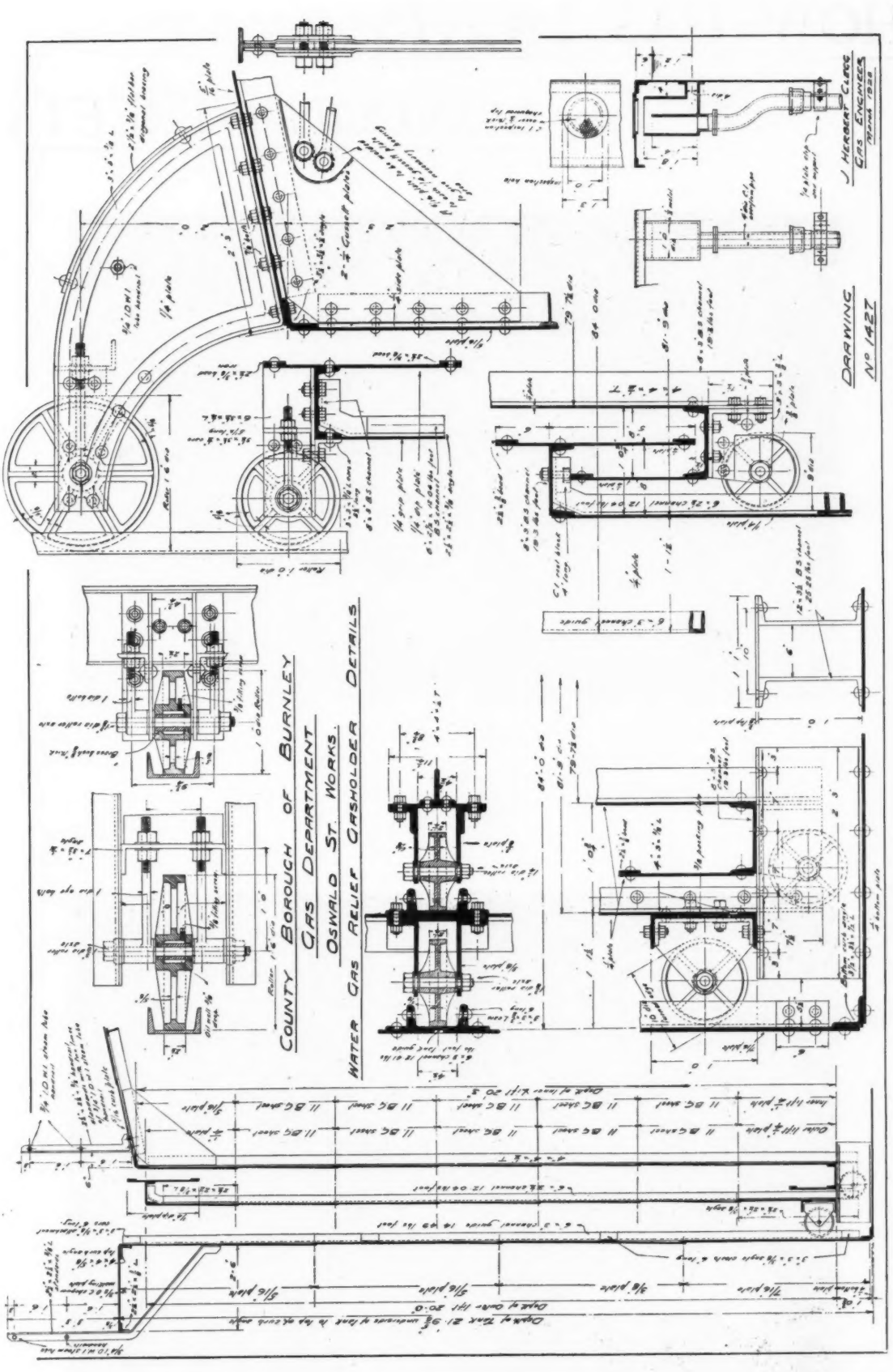


DIAGRAM 3.—DRAWINGS OF C.W.G. RELIEF HOLDER.

(*Continued on p.* 16.)

HOW GAS LIGHTS LONDON STREETS

PARLIAMENT SQUARE.

High-pressure and low-pressure gas lighting. The candle-power of the high-pressure lamps in this picture is 2000, and of the low-pressure units 800, 400, and 180.

CANNON STREET.

High-pressure gas lighting. Candle-power of lamps 1000. This central suspension lighting has been in use for twenty years.

Examples of excellent street lighting by gas in the areas traversed by the Institution during their "London by Night" Tour on Wednesday, June 3. The first four views were taken in the area of the Gas Light and Coke Company

ALDWYCH.

VICTORIA STREET.

High-pressure lighting. Candle-power of units, 2000.

MORE PICTURES OF GAS LIGHTED THOROUGHFARES IN LONDON

EFFECTIVE HIGH-PRESSURE CENTRAL SUSPENSION LIGHTING.

ANOTHER EXAMPLE OF HIGH-PRESSURE GAS LIGHTING.

The photographs on these two pages are of gas lighting installations in the area of the South Metropolitan Gas Company

LOW-PRESSURE LIGHTING.

A FURTHER VIEW OF LOW-PRESSURE LIGHTING.

constructed for a working pressure of 200 lbs. per sq. in. Attached to the base of the boiler is a hinged door which gives access to all tubes from a pit placed under the boiler, which is also raised above the ground level.

Special means are provided in the centre of the boiler for cleaning the tubes on the water side. The increased mass of water due to this central clearing space is additional reserve or store heat, which is a valuable feature when heat is given to a boiler intermittently.

The boiler can be disconnected from the plant in a reasonable time for cleaning or should repairs be necessary.

All the boilers on the works except this are fitted with " thermofeed " control, but in this type of boiler the intermittent evaporation precludes the use of such an arrangement, and the level is easily controlled by the attendant by an easily-accessible feed valve.

A dust interceptor of the wet type is attached to the blast outlets, the water supply being automatically controlled by opening and closing of the cock by the stack valve lever. The " U " portion of this interceptor is constructed of cast iron to withstand the acid corrosion. The plant is fitted with adequate interlocking devices, safety reliefs, and leakage indicators, with air meter for each of primary and secondary air supplies, and steam meters for the steam to generator.

The oil meter, besides registering the total oil, indicates the gallons per run and will automatically close the supply of any pre-determined quantity.

The plant is fitted with a pyrometer set for control of gas-making, with deviation indicator and temperature recorder. Temperature signal lamps, red, white, and green, are fixed for the ready guidance of the operator.

A wash or seal box of ample dimensions is provided as a centre for all the gas connections, and outside the building a scrubber with wood filling and a water tube condenser are erected. The latter is constructed to withstand a water pressure of 40 lbs. per sq. in., having a cooling surface of 3000 sq. ft. The large gasholder tank being in close proximity to this plant, the water is drawn from it for cooling purposes when this can be done without unduly raising the temperature of the bulk of the water in that tank; this arrangement is particularly helpful in frosty weather.

Externally also is constructed a series of separating tanks below ground level, where the water and tar are easily separated, cool water being returned to a ferro-concrete high level tank erected over a portion of the power house, for re-circulation, the tar being pumped by hand through a sight feed when it flows by gravity to the tar wells.

Overhead coke bunkers, each of 10 tons capacity, and fed by a belt conveyor running along a covered bridge from the coke handling plant, supply coke from a screen chute direct to the generator; having previously been roughly screened, a very small amount of screenings only are obtained in the basement.

The final tests on this plant produced the guarantee required, that after 14 days' working, that the four items of the B.W.G. test should be obtained simultaneously and the five items of the C.W.G. similarly.

Blue Water Gas Test.

(1) Gas production per day to be not less than 750,000 c.ft. corrected to 30 in. bar. press. and 60° Fahr.
(2) Net generator carbon consumption not to exceed 32 lbs. per 1000 c.ft.
(3) Net generator steam consumption not to exceed 35 lbs. per 1000 c.ft.
(4) CO_2 not to exceed 5·5 per cent.

Carburetted Water Gas.

(1) The gas production per day to be not less than 800,000 c.ft. when producing 500 B.Th.U. gas, corrected to 30 in. bar. press. and 60° Fahr. temperature.
(2) The net generator carbon consumption not to exceed 28·6 lbs. per thousand cubic feet.
(3) The net generator steam not to exceed 31 lbs. per thousand cubic feet.
(4) The net amount of gas oil not to exceed 2 gallons.
(5) CO_2 not to exceed 4·8 per cent.

The net carbon consumption for the generator provided for the waste heat boiler working with feed water at 100° Fahr. and at least 120 lbs. per sq. in. pressure, and generating 75 per cent. of the weight of steam required to work the plant on blue water gas.

Relief Holder.

The water gas relief holder (Diagrams 2 and 3) is a two-lift frame-guided steel holder and tank. This type was selected in preference to the spiral-guided because of the tendency of adhesion of tar and dust to the exterior of a holder when used for carburetted water gas, the author having experienced trouble in this connection at another gas-works.

The inner lift is 79 ft. 7½ in. by 20 ft. 3 in. deep, and the outer lift 81 ft. 9 in. by 20 ft. deep.

The tank is 84 ft. diameter by 21 ft. 9⅜ in. deep overall, and the inlet and outlet pipes are 24 in. and 20 in. diameter respectively. The tank is constructed of bottom plates arranged inside the bottom curb angle, which are ¼ in. in thickness and ⅜ in. where the connections pass through.

There are four tiers of side plates, 7/16 in., ⅜ in., 5/16 in., and 5/16 in. respectively. The longitudinal seams are lap-jointed, and the vertical seams jointed by double butt covers. The platform is built into the top curb and is supported at the outer edge by angle brackets. Twelve vertical piers of 14 in. by 6 in. by 46 lbs. per foot R.S.J. form the base length for guide framing, and act as stiffeners to the tank. The tank guides are formed of 6 in. by 3 in. B.S. channels. There are 24 rest blocks in the bottom of the tank.

There is a spiral staircase to the platform, 5 ft. in diameter, and the overflow box is arranged to prevent floating tar from escaping into the drains.

The tank framing and other structural work is designed with a factor of safety of 4½ at the weakest parts.

The inner lift cup is formed by an 8 in. by 3 in. B.S. channel with a ¼ in. skirting plate stiffened by a flat steel bead, and is 1 ft. 3¾ in. in depth and contains cup rests 1½ in. in thickness.

The crown of the holder is sheeted in 11 Birmingham gauge sheets, except the two sheets near the crown curb, which are 1/16 in. and ¼ in. thick respectively, and the centre plate 5/16 in. Twenty-four vertical stays of 4 in. by 4 in. by ½ in. " T " section are fitted. The top angle is of 3½ in. by 3½ in. by ½ in. section. The crown is trussed with 4 in. by 4 in. by ½ in. main radiating rafters strutted with angles and tied by round steel bars to a centre pillar of 1 ft. 3 in. diameter. 9 in. by 2½ in. cast steel rollers, brass bushed, are provided, and lubrication by grease gun is arranged.

The outer lift is similarly constructed.

The standard guides are of 6 in. by 3 in. B.S. channel, and secured to each standard. Two rows of horizontal struts 12 in. by 6 in. are attached to the 14 in. by 6 in. standards, and the diagonal wind ties are 1¼ in. diameter in the top and 1½ in. in the bottom bay.

A 3 in. tar run-off is provided at the base of the tank.

The foundations, although requiring to be thicker under one half of the tank, presented no difficulty, and were laid in bulk concrete.

Chemical Works Section.

This section is situated at the far end of the main road through the works and on the left-hand side. A railway siding runs between this and the purifiers, and beyond to the workshops and stores.

This plant consists of a concentrated liquor and tar distillation plant. The former is erected in a separate building designed to accommodate two 6-ton per day sulphate of ammonia plants, with a sulphate store longitudinally adjoining, but separated from the sulphate house except for an opening intended for the provision of an elevator. This building, although otherwise built on the same lines as the remainder of the works, is roofed entirely in timber covered with protected metal sheeting, and the window frames are made of the same material, whereas in the remainder of the buildings throughout the works, roofs and window frames are of steel. The dimensions of the whole building are 70 ft. by 48 ft. 9 in. by 24 ft. 9 in. to the eaves. The building is ventilated by 14 large protected metal ventilators.

A lime store is screened off at the end of the sulphate house along the railway siding, the floor of which is at wagon-loading height. The end of the sulphate store also opens out to the same siding, and is arranged with a covered loading bay.

Along the whole length of the building are arranged the settling tanks externally and below ground level, which are entirely covered by cast-iron floor plates. The tanks are 6 ft. deep at the building side, and taper out to the side road for the easy scraping-out of the sludge. The tanks are divided into two sections, so that the spent liquor may be run from the centre either left or right or both. After settling, the effluent is run into the main sewer.

When the house was nearing completion it was decided to install a 6 tons per day concentrated liquor plant instead of a sulphate plant. The income from sulphate of ammonia had by then closely approximated if not become less than the cost of production. This plant produces crude concentrated liquor containing about 15 per cent. ammonia, and is capable of extension to a complete sulphate plant if required.

The still is of the Wilton type, with a separate liming chamber, and is composed of 21 rings forming a vertical column 20 ft. high by 4 ft. internal diameter. It is complete with automatic liming pump and the usual Wilton accessories.

The liquor heater for preheating is of cast iron, vertical, and contains 17 cast-iron 3-in. tubes fitted with expansion joints.

The strong ammonia condenser is formed of a cast-iron coil of 4 ft. 6 in. centres with 14 laps.

A sight glass is provided to observe the strong liquor produced, which is stored in two mild-steel boiler tanks, each of 4000 gallons capacity.

A cast-iron bubbling box is provided to entrap escaping gases from the end of the condenser and tanks. Two covered cast-iron rectangular tanks are placed on a ferro-concrete superstructure outside the house for the supply of weak-liquor to the plant and for measuring purposes. Water and steam meters are provided.

All the lime used is slaked and mixed in the lime store by means of spent liquor.

Tar-Works.

The tar distillation plant proper is completely housed in a building in which northern lights are provided in the roof. At the back of this house is a sunken floor accommodating the immediate receiving and cooling pans of the distillates. This is about 8 ft. below ground level, and provides for the gravitation of the distillates. It is covered-in except at the ends, the windward side and roof being covered with asbestos sheets on steel framing. On the left of the plant house is a double-floor superstructure, the first floor being a barrelling stage for creosote oil and tar if required. It also accommodates the filled barrels, and is placed at road vehicle loading level. The second floor accommodates storage tanks, which are filled by pumping from the central sump in the basement oils graded from the reception tanks. Road tar is also stored here, and therefore gravity filling of rail and road tanks and barrels is possible.

The plant, which distills the tar to first products or produces road tar as desired, is capable of distilling 50 tons of tar in 24 hours. It is of the Hird's continuous type, and comprises one Wikner steam dehydrating still, three Hird stills, with heaters, condensers, sight overflow boxes, and pitch cooler. The stills are heated by town's gas, and all steam and water used is measured.

The guarantees provided for consumptions of steam of 1000 lbs., water 400 gallons, and gas 1200 c.ft. per ton of tar distilled.

To the north of the reception tanks is an elevated floor for the bagging of crude naphthalene salts, which are carried from the tanks after draining in a 2-cwt. skip on a hand-operated runway. This platform is at road vehicle loading level.

A small purifier is provided adjoining this stage for the removal of obnoxious uncondensed gases from the stills. To the north of the plant house at a lower level are four pitch bays with a capacity of 500 tons of pitch. The railway encloses two sides of the pitch yard, from which pitch is loaded into railway wagons by the steam crane and grab previously mentioned. The pitch yard and bays can also be entered by road vehicles.

Behind the pitch bays and between the sidings is a plot of land reserved for the possible erection of refining plant. In this corner, at the end of the purifiers, is erected a tank of 500 tons capacity for the reception of road tar. This large quantity is stored for the purposes of ensuring that the tar will be consistent in quality and to the Road Board Specification.

Opposite the tar plant and across the main works road is placed the mixing plant in which is mixed a proprietary road tar. These tanks are arranged for road, rail, and barrel filling by gravity.

Workshops.

The workshops and stores are housed in one building sub-divided into joiners', wheelwrights', mechanics', electricians', and smithy. The stores run behind these works, and are accessible from each shop by serving counter so that the workshop employees can be readily supplied. The goods for each trade are kept opposite the particular workshop for which they are required, and loss in time is thus largely eliminated.

The stores are replenished from a side road or from the railway siding which runs behind the length of the stores.

The stores and workshops are well equipped, and are driven and lighted electrically. The roof is of the north light type, and the interior walls are of breeze concrete blocks. The floor of the mechanics' shop is of creosoted deal blocks, and the joiners' shop of Columbian pine blocks.

Other Works Buildings.

Commodious messrooms with canteen and shower baths are provided for day and shift workers. The health and comfort of all employees have been carefully considered. Other buildings include a chemical laboratory and office, coke and coal office with weighbridge, works offices, motor and steam wagon garages, locomotive shed, timber store, gatekeeper's kiosk, and numerous conveniences.

The chemist will consider that scant attention has been paid to the laboratory, but it must be said that the main laboratory is situated away from these works. The new one referred to, although equipped and arranged with particular care, is only used for routine tests.

Water Supplies.

No natural water supplies were available except a variable and small quantity from Barden Clough, which intersects the site. A portion of this water, which is polluted before it arrives at the works, is elevated by an Estate ram to an overhead tank placed over the tar distillation store tanks, and adjoining the tar feed tank for that plant. From this is drawn for cooling purposes all the water required for the tar and ammonia plants.

The remainder of the water used is town's water, which is supplied to a ferro-concrete water tower closed top tank, shown in the photograph. This tank is of 20,000 gallons capacity at a height of 70 ft. A branch main is taken off for fire, domestic, and furnace purposes, and the remainder feeds through a Kennicott softening plant situated in the house at the base of the tower to the overhead tank. From this reservoir water passes through the coal gas condensers to the hot feed tank over the C.W.G. power house, and from thence through the exhaust steam heater to the respective works boilers.

It is interesting to note that for experimental purposes bituminous lined steel tubes were used for a portion of the cold water main pipes, copper lined lead pipes for service purposes; concrete lined cast-iron and bituminous lined steel were used for warm water to the feed tank. No trouble has yet been experienced with any of them; therefore the author is unable to compare at this stage the respective merits of the types employed.

The hot water is conveyed in galvanized wrought iron tubes laid underground and encased in concrete to the respective boilers, and where above ground these are insulated.

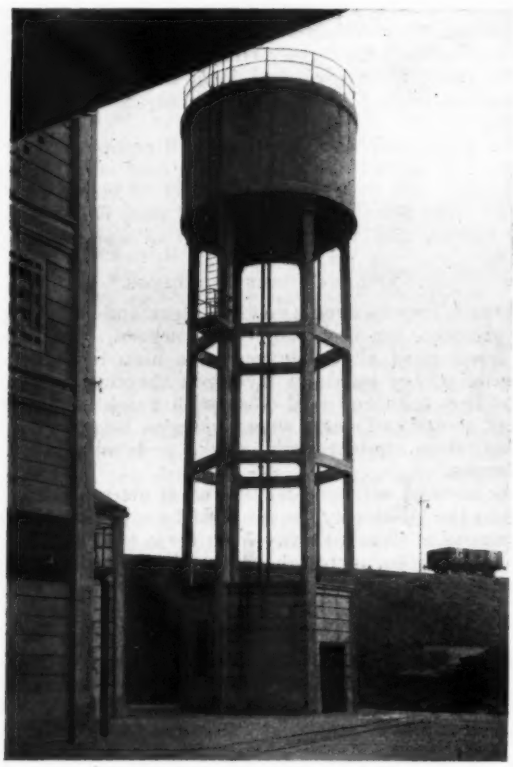
The surplus condenser warmed water is gravitated to

the two water cooling towers. The first one is of the open type, and the second of the closed fan draught type. From here it is returned by centrifugal pump to the ferro-concrete tower tank for further circulation. At certain times of the year the water can be pumped direct from the hot water tanks, the radiation from the return pipes, with the addition of make-up town's water, ensures that the whole is sufficiently cool.

The adjoining canal water is too warm for condenser use, having been used continuously by many neighbouring cotton mills, and its quality does not commend it for use in steam boilers of the multitubular type.

Utilization of Exhaust Steam.

As previously mentioned, the steam is exhausted from the electricity generating sets, exhausters, &c., at 3 lbs. gauge pressure, for utilization in the heating of the workshops, stores, laboratory, and messrooms blocks by a vacuum heating system and for other purposes by means of steam pipes, wall and floor radiators. The return condense mains from these points are led back to the water



Water Cooling and Storage Tower.

gas machinery house, in which is installed an electrically driven centrifugal vacuum pump with double impellors for exhaust, air, and condense water, together with a condense receiver. The condense water is returned from the system *via* the pump to the works hot feed water tank.

The system is so arranged that if through any cause should the supply of exhaust steam be insufficient for these purposes a low-pressure live steam supply will make up the deficiency.

The author is of the opinion that insufficient use is made of the available heat of exhaust steam in gas-works practice, and that considerable economies can be effected thereby. There are many other operations which can be conveniently carried out by its use, some of which are employed in these works, such as the heating of domestic water supplies for kitchens and messrooms, the heating of the gas at the inlet to the purifiers, provision of steam to the gas stream to the purifiers, and the heating of various oils and liquids made and used on the works.

Probably by the use of heat extraction engines exhausting at back pressures of (say) 20 lbs. to 30 lbs. gauge pressure, further economies could be attained in the cost of manufacture of water gas and ammonia liquor distillation by the use of the exhaust steam at about these pressures on the above plants.

Electricity Distribution in Works.

The distribution of electricity from the power house to the various parts of the works is effected by five sets of main distribution cables which are in all cases carried overhead by cable racks and span wires.

These cables are of single core, single wire armoured paper insulated variety, and terminate at their outward ends in control panels carrying distributor switches and fuses.

The service cables are of single core vulcanized india-rubber, and generally wherever possible are carried on 1-in. thick batten boards by porcelain cleats so as to be both visible and accessible.

Lighting Circuits.

All lighting circuits are of single core V.I.R. carried on batten boarding, as previously described, or by span wires.

Switchgear.

All switchgear and control panels outside the power house are of the " Ironclad " type, arranged for either floor or wall mounting as may be required, and fitted with cable sealing glands. The gear has been designed to be dust, gas, and flame proof, and is efficiently earthed.

Electric Motors.

All electric motors over 3 H.P. are supplied with current at 440 volts D.C. The motors generally are of the pipe-cooled totally-enclosed, gas and dust proof type, the exceptions being on the retort house charging machine and water cooling plants. In these cases the use of pipe-cooled motors could not be adopted due to space requirements or for other special reasons.

Costs.

The new works were started up in November, 1927, and although it may sound incredible in view of the fact that 120 different contracts were let in the construction of the works, and 82 different contractors had been engaged whose work required " welding-in " to the adjoining contract, no hitch in the slightest degree was experienced except that one conveyor ran in the reverse direction.

The first charge was placed in the retorts at 8 a.m., and by 12 noon the station meter was registering the gas to the holder.

The costs of the erection are shown in Table 1 in the Appendix, and although it is hardly practicable to give exact details of every item so that they may be followed in a general paper of this description, the detail given may be of use to some of the members in considering future extensions, although contracts which have been made subsequently have indicated a reduction in price during the last 12 or 18 months.

Table 2 in the Appendix also gives the costs of maintenance detailed for different portions of the works, these items have been carefully recorded since starting-up. Other figures are given in Tables 3, 4 and 5. The plant is, of course, still fairly new, and when renewals take place the average figures over a period of years will, necessarily, be increased.

FURTHER EXTENSIONS.

As has been previously explained, the unit now reviewed was not sufficiently large to supply the requirements of the undertaking, and the old works at Parker Lane had to be operated in the winter months.

In May, 1928, the author reported to the Burnley Town Council that it was advisable to consider the concentration of the production of the whole of the town's supply of gas at Oswald Street, and to shut down the Parker Lane Works, the cost of production at the old works being 9d. per 1000 c.ft. higher than at the new works. Consequently, a scheme of extension was prepared for the provision of a new carbonizing plant of 1½ million c.ft. per day capacity, with a retort house, coal stores, and subsidiary plant designed to deal with 3 million c.ft per day.

From the very earliest beginnings in connection with the erection of their new works, the Council had in mind the possibility of purchasing a supply of surplus gas from the local colliery owners, who had been contemplating for some years the erection of low-temperature carbonization plant. This determined the erection of a plant, in the first instance, which was not adequate in capacity to supply the whole of the town. As it was not deemed wise

for the Council to wait longer, the extension scheme referred to was prepared.

In the meantime the colliery owners approached the Committee with an offer of coke oven gas, they having decided to drop their scheme of low-temperature carbonization and amalgamate with two other collieries in the district, who had already commenced to work bye-product coke ovens and were negotiating for supplies to a neighbouring authority.

Without entering into a discussion of the pros and cons of the advisability of purchasing coke oven gas—this in itself would form the subject of a paper—it might be said that largely owing to local considerations the Burnley Council decided to purchase 1½ million c.ft. per day of coke oven gas.

In this connection, a sum approximating £47,000 has since been expended in the provision of about 7 miles of 10-in. main for the purpose of conveying this gas from the coke ovens and for the provision of subsidiary plant. The first mile of main is of cast iron, and is buried in private land and in the public highway. The remainder is of steel, 5 miles of which is laid along the L.M. & S. Railway from Huncoat Station to Burnley, the major portion being laid above ground on short brick and concrete pillars on the embankment, and in cuttings is buried 1 yard deep.

The buried main is wrapped and coated in the usual manner inside and out, and the exposed main is coated with bitumastic enamel to a final thickness of about $\frac{3}{32}$ in.

Horseshoe corrugated expansion bends are laid where necessary in the exposed main, about twelve being employed.

The remainder of the main is laid underground for 1 mile, and then along a mineral railway almost up to Oswald Street Works.

The welded type of joint was employed, and the whole was carried out by direct labour. Some interesting small engineering problems were encountered in this construction.

The gas purchased is crude, and of 500 B.Th.U. quality, but contains only 275 grains of H_2S per 100 c.ft. in comparison with 800 grains in a similar quantity of our own gas. The gas is washed for naphthalene at the coke ovens by rotary brush washer with blast furnace oil.

Purifiers.

A further unit of six purifiers constructed in exactly the same manner, except that the four rotating boxes come first in the stream, and the two single or series boxes as second takers, and to the same dimensions as the first installation, was erected to deal with this gas at the Oswald Street Works. The revivifying shed and floor were doubled in capacity.

At the inlet to the purifiers is placed a steam preheater, and the air pipes from the blowers and steam pipes were extended to these purifiers for the admission of steam and air.

Some road extension was involved, and a new railway siding laid alongside the new purifiers for emptying and filling purposes.

Carburetted Water Gas.

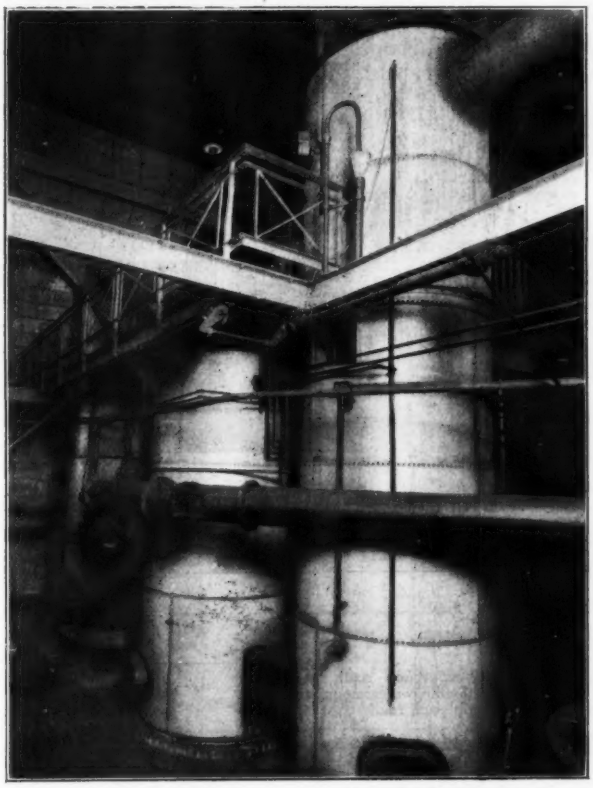
A No. 2 C.W.G. plant has also been erected of a capacity of 1,350,000 c.ft. per day of 500 B.Th.U. gas as a standby against possible failure of the coke oven gas supply. This plant is of the Humphreys & Glasgow latest standard pattern except that a scrubber is erected in addition to the wash-box and condenser. The plant includes their three-phase cycle back-run process, in place of the waste-heat boiler. As this plant will be worked very little it was considered advisable to install a separate boiler which could be used for either purpose, rather than having it standing completely idle except when this plant was working.

The fans and pumps previously installed serve also this new plant.

The net fixed carbon consumed in the generator in the guarantee test did not exceed 24 lbs. per 1000 c.ft. of C.W.G. of 500 B.Th.U. quality produced, and the quantity of dry steam 33 lbs. with an average of not more than 50 c.ft. of CO_2 per 1000 c.ft. A centriflovane was erected on this plant on account of convenience of installation. It is, however, not possible yet to compare the wet and dry type of dust extraction; both systems are working very successfully.

The boiler installed is a gas-fired horizontal tubular boiler of the Spencer-Bonecourt pattern, with a capacity of 7000 lbs. evaporation per hour from and at 212° Fahr. The pressure is at 200 lbs. per sq. in., and this boiler is used for standby purposes when any of the other boilers are closed down for cleaning or repairs.

Another Livesey washer and connections were installed from No. 2 exhauster to the purifiers as a part of the preconceived extension for a No. 2 unit and to permit of the handling of the carburetted water gas.



Humphreys & Glasgow C.W.G. Plant.

The costs of this part of No. 2 section are as follows:—

	£	£
10 in. connecting main—1735 yards in cast iron, 9304 yards in steel, with intersecting valves, expansion bends, and all fittings, including enamelling and reinstatement		19,363
One 1,350,000 c.ft. water gas plant, with foundations, extensions to coke bunker, and conveyor, &c.	7,129	
One Livesey washer and connections	441	
		7,570
Six purifier boxes, with revivifying floor extension, valves and connections, electric cable, and sundry pipes	14,250	
Extension to revivifying shed	800	
		15,050
Railway siding		750
Road extension		200
Meter and meter house, valves, and specials, including lighting and heating		1,601
Gas-fired boiler and connections, steel-framed house covered with protected metal sheeting, meters, &c.		1,750
Calorimeters, gauges, and calorimeter house		720
No. 2 syphon pumping apparatus, sundry connections, &c.		200
		£47,204

CONCLUSION.

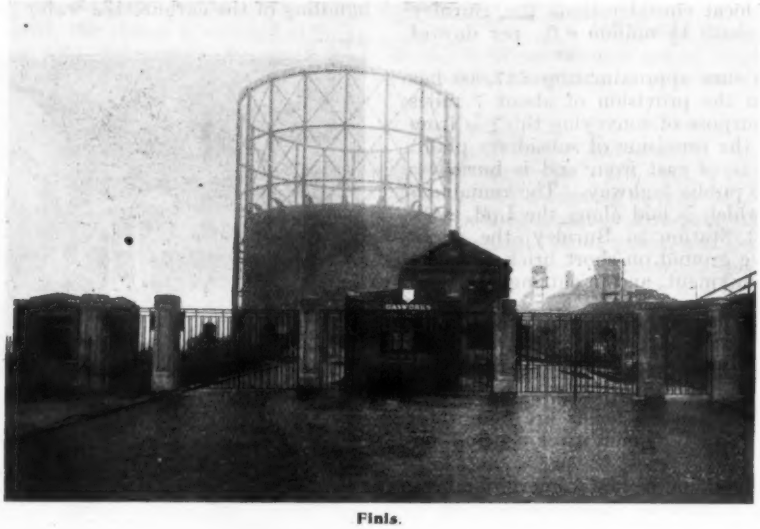
The final test by which the policy of an undertaking can be judged is, of course, the service which the undertaking renders to its customers and the final results. The works, whilst not by any means entirely controlling these factors, must undoubtedly play a great part in their achievement.

Up to March, 1930, it will be observed that a capital sum was expended in the Burnley Gas Undertaking on manufacture and storage only of £360,000. The bold policy of scrapping entirely an unsatisfactory works may be considered a wise one in view of the fact that after

providing for the interest on the capital expended and after paying the annual sinking fund charges, price reductions had been conceded by March 31, 1930, to the general consumers of £38,457, industrial consumers £1357, and for public lighting £3206 per annum, whilst each year a substantial net balance has been available.

In conclusion, the author wishes to acknowledge the assistance of Messrs. F. N. Howes, A. D. Young, C. E. Byrt, and W. O. Hilton, all of whom at some period were identified with the carrying out of the installation described, and all of whom have secured more responsible positions in the meantime.

Owing to the unfortunate death of his Engineering Assistant, Mr. R. A. Williams, a month ago, by the kindness of Messrs. Newton, Chambers, & Co., Ltd., his late Assistant, Mr. A. D. Young, has rendered assistance in the preparation of drawings for reproduction, without which it would have been impossible to present this paper in its present form in the short time the author found available.



Finis.

APPENDIX.

TABLE 1.—*Complete Costs—No. 1 Unit.*

—	£	£	Percentage.
1.—Land . . . . . 23¾ acres	9,000		
5¼ acres	1,800		
		10,800	3·00
2.—Temporary approach road, boundary walls and fencing, diversions, and permanent approach road		6,623	1·84
3.—Drainage and sewering, roads, yard surfacing		17,722	4·92
4.—Railway siding, top level	18,705		
Bridge	819		
Works sidings and loco. shed	15,541		
		35,065	9·74
5.—Carbonizing—			
Buildings, &c.—			
Retort house building, coal stores, and messrooms	19,065		
Roof ironwork	3,334		
Sheeting	839		
Sundries	240		
Stage floors	3,700		
Plant—		27,178	7·55
Retort bench and foundations, chimney, &c.	21,419		
Coal plant	5,575		
Capstan	498		
Retort fittings	3,350		
Stoking machinery	2,300		
Foul mains	255		
Retort house governors	325		
G.N. machine	1,934		
Tar shields	105		
Coke shoots	541		
Congdon installation	6,000		
Gas, water, electricity supplies, sundries, and direct labour	3,638		
		45,940	12·75
6.—Coke handling exterior to retort house, coke storage, cooling, and part steaming—			
Rail track outside retort house . . .	154		
Sulzer plant in duplicate, with waste-heat boilers, hoist, &c., subsidiary bunkers, and foundations	18,587		
Recorders and pyrometers	198		
Fireless loco.	1,378		
Elevator, six large storage bunkers, four small bunkers, crusher, screens, conveyors, bridge and platforms. .	7,829		
Foundations	368		
Four additional small coke bunkers .	1,725		
Foundations	850		
Direct labour materials, connections, &c.	526		
		31,615	8·78

TABLE 1—(*continued*).

—	£	£	Percentage
7.—Condensing main and supports . . .	272		
Direct labour, materials, and foundations	258		
Condensers	1,297		
Valves	167		
		1,994	0·55
8.—Power and C.W.G. house—			
Building—			
Excavator, concretor, and joiner. .	6,244		
Roofwork steel	1,262		
Roof sheeting	239		
Painting	166		
Tiling, flooring, window frames, and other trades, wood office, &c. . .	2,110		
		10,021	2·78
Machinery in power house—			
Exhausters and foundations . . .	1,685		
Air blowers	115		
Electrical generating plant and foundations	2,524		
Switchboard	197		
Travelling crane.	124		
Floor framing and castings . . .	263		
Central pyrometer system . . .	399		
(C.W.G. machinery under "C.W.G. plant.")		5,307	1·47
9.—Wet purification—			
Tar and liquor storage, &c.—			
Underground tar and liquor tanks .	4,860		
Ironwork fittings	235		
Overhead tar and water tanks . .	706		
Livesey washer	380		
Rotary washers	3,277		
Concrete supports	114		
Gangways and decking.	145		
Syphon emptying, vacuum system .	143		
		9,860	2·74
10.—Purification—			
Steam heating—			
6 purifier boxes, covers, and crane, connections	8,536		
Grids	380		
Foundations, retaining wall, and revivifying floor	4,589		
Steelwork, gangways, and handrails	249		
Steel roof over revivifying floor and sheeting	1,267		
Conversion of crane to conveyor. .	405		
Gas valves	665		
Oxide breaker	366		
Electric lamps, cables, and sundries	2,396		
		18,853	5·23
11.—Naphthalene washer		1,189	0·33

TABLE 1.—(*continued*).

—	£	£	Percentage
12.—Station Meter—			
House to accommodate	235		
Meter, 150,000 c.ft. per hour	680		
Connections	217		
Valves	120		
Flooring to meter house	57		
		1,309	0·36
13.—C.W.G. Plant—			
Gas oil tanks	1,150		
Foundations and retaining wall	583		
Plant, 800,000 c.ft. per day	7,700		
Foundations	480		
Indicator	37		
Relief gasholder and steel tank, 200,000 c.ft. capacity	5,335		
Foundations	1,881		
Inlet and outlet mains	335		
Approach	82		
Sundries, instruments, pipe fittings, lighting, &c.	788		
Connersville meter, 90,000 c.ft. per hour	680		
Connections	548		
		19,599	5·44
14.—Sulphate of ammonia plant house, &c.—			
Building, settling tanks, &c.	4,279		
Chequer plates	194		
Concentrated liquor plant, 6 tons per day	2,202		
Foundations and floor	247		
Specials and platform	32		
		6,954	1·94
15.—Tar handling and distillation—			
Building, excavator, and concretor	2,032		
Steelwork roof	1,342		
Sheeting, &c.	209		
Pitch bays, paving and other concreting	3,273		
		6,856	1·90
Plant	5,305		
Foundations	220		
Meters, specials	228		
Troughs and tanks	520		
Gangways	960		
		7,233	2·01
16.—Other boilers and steam equipment—			
Waste heat boiler retort house	3,058		
"Economic" boiler, superheater, and steel chimney	1,995		
Foundations and setting	205		
Feed water heater	79		
Oil separator	55		
Boiler feed pumps	190		
Steam and exhaust mains (contracts)	1,676		
,, ,, ,, valves, materials, and direct labour	600		
Steam exhaust heating apparatus and pump	868		
		8,726	2·42
17.—Water—			
Water supply from Water Works Dept.	355		
Water meters throughout works	241		
Water valves, hydrants, fittings	110		
Tank for boiler feed	187		
Water softening plant	297		
Concrete water storage tower	1,350		
Water cooling towers	294		
Foundations	173		
Centrifugal pumps and motor	297		
Pipes and trestles	298		
Hydraulic Estate ram	105		
Sundry pipes, direct labour, water services, &c.	722		
		4,429	1·23
18.—Gas mains not previously accounted for		3,219	0·90
Electric mains and switchgear not previously accounted for, and lighting		1,867	0·52
Gas lighting and services		1,546	0·43
19.—Workshops and stores—			
Building		6,765	1·88
20.—Buildings only—			
Office building	1,242		
Garages	1,040		
Laboratory and messroom	2,449		
Boiler house and pump house	754		
Governor house	688		
		6,173	1·72
21.—Steam travelling crane and grab	1,387		
Locomotive	1,661		
		3,048	0·84
Laboratory fittings and scientific instruments	550		
Messrooms, furniture, &c.	71		
Office fittings, furniture, &c.	300		
Weigh bridges	635		
Workshops machinery, and stores equipment	1,705		
		3,261	0·90
1923—			
Previously constructed 3-million c.ft. gasholder, column-guided	34,500		
Masonry tank	19,500		
Connections	3,000		
		57,000	15·83
		£360,152	100·00

TABLE 2.—*Expenditure on Maintenance of Works, Oswald Street, November, 1927, to 31st March, 1930.*

—	Materials.	Wages.	Total.	Cost per 1000 C.Ft. Gas Made.
	£ s. d.	£ s. d.	£ s. d.	d.
Retort house	275 18 5	890 13 0	1,166 11 5	0·126
Coal handling plant	77 2 4	140 1 8	217 4 0	0·024
Waste heat boiler	20 17 8	134 1 6	154 19 2	0·017
Charging machine	242 0 9	138 14 5	380 15 2	0·042
Fireless loco.	6 6 4	33 17 5	40 3 9	0·004
Sulzer plant	273 14 11	552 17 6	826 12 5	0·090
,, boilers	23 16 3	70 10 10	94 7 1	0·010
Coke handling plant	269 7 11	381 0 2	650 8 1	0·071
G.N. machine	124 16 6	95 15 9	220 12 3	0·024
C.W.G. plant	103 1 5	196 7 11	299 9 4	0·033
Tar distillation plant	113 18 3	119 8 0	233 6 3	0·025
Conc. liquor plant	22 9 10	66 5 9	88 15 7	0·010
No. 1 loco.	64 18 1	109 8 9	174 6 10	0·019
Solid fuel boiler	47 19 6	109 4 5	157 3 11	0·017
Condensers	3 16 9	0 12 3	4 9 0	..
Washers	15 14 0	41 16 7	57 10 7	0·006
Pumps	46 11 4	132 16 11	179 8 3	0·021
Purifiers	100 11 4	142 16 0	243 7 4	0·026
Exhausters	11 19 9	..	11 19 9	0·001
Engine house	25 10 11	27 2 10	52 13 9	0·006
Governor	27 11 0	..	27 11 0	0·003
Syphon vacuum mains	2 14 7	26 10 10	29 5 5	0·003
Crane	16 1 5	33 7 3	49 8 8	0·005
Electric generating set	5 19 5	35 2 2	41 1 7	0·004
Electricity maintenance	58 14 2	..	58 14 2	0·006
Steam mains	..	51 3 5	51 3 5	0·006
Capstan	0 17 0	..	0 17 0	..
Weighbridges	10 4 2	..	10 4 2	0·001
Tar and liquor wells	..	0 16 3	0 16 3	..
Water softener and cooling plant	20 0 4	15 3 2	35 3 6	0·004
Water supply, Barden Clough	13 8 0	11 10 9	24 18 9	0·003
Railway sidings	35 6 8	286 11 10	321 18 6	0·035
Connersville meter	0 10 6	2 10 0	3 0 6	..
Messroom	34 3 5	..	34 3 5	0·003
Workshops, implements, and machinery	44 14 7	..	44 14 7	0·004
Heating	..	6 9 3	6 9 3	0·001
Works telephone maint.	27 18 2	..	27 18 2	0·003
Works lighting	18 19 2	4 5 10	23 5 0	0·003
Tar main	0 0 10	6 4 6	6 5 4	0·001
Water mains	18 14 9	9 3 10	27 18 7	0·003
Loco. shed	2 14 0	18 4 4	20 18 4	0·002
Paint and painting No. 5 holder	567 10 2	..	567 10 2	0·062
Recorders and charts	19 6 0	..	19 6 0	0·002
Road renewals	68 4 1	..	68 4 1	0·006
Water	2770 16 0	..	2,770 16 0	0·301*
Works lubrication	420 10 3	..	420 10 3	0·046
General	654 12 10	3837 1 8	4,491 14 6	0·489
Totals	£6710 3 9	£7727 16 9	£14,438 0 6	1·568

*This cost of water is abnormal, the present cost per annum being £660.

—		Cost per 1000 C.Ft. Gas Made.	Cost per Ton Coal Carbonized.
	£ s. d.	d.	d.
Material	6,710 3 9	0·729	11·96
Wages	7,727 16 9	0·839	13·77
Totals	£14,438 0 6	1·568d.	25·73d.

	d.
Sulzer plant, cost per ton coke handled	3·19
G.N. machine, ,, ,, ,,	0·76
Coke handling plant, ,, ,, ,,	2·25
Fireless loco., ,, ,, ,,	0·14
Total	6·34d.

	d.
Coal handling plant, cost per ton carbonized	0·38
Carbonizing plant, ,, ,, ,,	3·04
Total	3·42d.

TABLE 3.—*Two Years* 1929 *and* 1930.

Coal carbonized	116,412 tons
Coal gas made	1,861,081,000 c.ft.
Therms per ton	75·9
C.W. gas made	64,437,000 c.ft.
Gas oil used	65,474 galls.
Coke made for sale per ton of coal carbonized	10·01 cwts.
Tar produced for sale per ton of coal carbonized	9·71 galls., or 1·09 cwts.
Ammonia (in terms of neutral sulphate of ammonia) produced per ton of coal carbonized	20·40 lbs.

Class of Coals Used.

—	Dank.	Washed Slack.	Singles.	Rough.
Per cent. of total	29	18	37	16

TABLE 4.—*Cost of Gas into Holder.*

Two Years ended 31st March, 1929 and 1930.

	£	s.	d.
Coal carbonized—			
59,520 tons at 17s. 10·5d.	53,196	0	0
56,892 ,, ,, 18s. 2·9d.	51,890	0	0
Gas oil—			
6,100 galls. at 4d.	101	13	4
59,374 ,, ,, 4·09d.	1,011	16	7
Coke and breeze used for steam raising and C.W. gas—			
550 tons at 13s. 8d. (1929)	375	16	8
814 ,, ,, 16s. 3d. (1930)	661	7	6
873 ,, ,, 12s. 6d. (1930)	545	12	6
Wages—			
Coal storing and unloading	1,380	1	3½
Coal gas wages	9,128	17	2
C.W. gas	317	15	4½
Purification (wet and dry)	1,224	14	2
Maintenance of works	6,690	15	9
Coke	6,063	18	5½
Tar	716	11	11
Liquor	432	6	9½
Technical, clerical, and administrative staff	3,168	19	8½
Steam raising, power house, &c.	1,853	4	7½
Materials on revenue	6,071	0	9
Gas for distillation	371	4	1
Gross cost into holder	£145,201	16	8
Less—			
Gross receipts from—			
Coke £50,384 15 5			
Tar 12,389 4 9			
Liquor 2,292 1 8			
	65,066	1	10
Net cost into holder	£80,135	14	10

Total gas made . . . . . 1,925,518,000 c.ft.
Net cost into holder, per 1000 c.ft. made . . 9·98d.
,, ,, ,, ,, ,, therm (475) ,, . . 2·10d.

TABLE 5.—*Wages Details for Two Years Ended 31st March*, 1930.

Coal carbonized	116,412 tons
Coal gas made	1,861,081,000 c.ft.
Do. therms	8,835,670·8
Do. per ton	15,987 c.ft.
Do. Do.	75·9 therms
Coal gas wages	£9128 17s. 2d.
Do. per 1000 c.ft.	1·17d.
C.W. gas made	64,437,000 c.ft.
C.W. gas wages	£317 15s. 4½d.
Do. per 1000 c.ft.	1·18d.
Coke to generators	863 tons
Do. lbs. per 1000 c.ft.	30·00
Gas oil used	65,474 galls.
Do. galls. per 1000 c.ft.	1·02
Total gas made (mixed)	1,925,518,000 c.ft.
Total gas-making wages	£9,446 12s. 6½d.
Do. per 1000 c.ft.	1·17d.
Maintenance of works	£6690 15s. 9d.
Do. per 1000 c.ft.	0·83d.
Wages, wet and dry purification	£1224 14s. 2d.
Do. per 1000 c.ft.	0·15d.
Concentrated liquor made	1388·97 tons
Do. wages	£432 6s. 9½d.
Do. per ton liquor produced	74·70d.
Tar works wages	£716 11s. 11d.
Tar distilled	3253·25 tons
Wages per ton tar distilled	52·86d.
Coke handling wages and sales	£6063 18s. 5½d.
Do. Do. per 1000 c.ft.	0·75d.
Technical, clerical, and administrative staff	£3168 19s. 8½d.
Do. Do. Do. per 1000 c.ft.	0·39d.
Steam raising, power house, &c., wages	£1853 4s. 7½d.
Do. Do. Do. per 1000 c.ft.	0·23d.
Coal handling wages	£1380 1s. 3½d.
Do. per 1000 c.ft.	0·17d.

Mr. CLEGG, during his presentation of the paper, said: Since the installation of this plant we have not experienced the slightest trouble with any portion of it. I have stated that in the paper in regard to the Congdon pipe system, but it is perhaps rather invidious to pick out any particular feature of the plant and commend it as being successful, because the whole installation has been successful.

DISCUSSION.

The PRESIDENT: I think you will all agree with me when I say that we have listened to a very remarkable paper. Mr. Clegg is fortunate, in that he has had the opportunity, which rarely falls to the lot of a gas engineer, to plan and complete an entirely new works, on a new site, and his paper has been prepared with meticulous care. It records an achievement which obviously must have entailed much careful thought and attention to detail. With regard to his decision to install horizontal retorts, it is to be noted that, in setting out the disadvantages of horizontal retorts, he has not referred to labour costs. I am particularly interested in his decision to install horizontal retorts, because it shows that we have by no means reached finality. We have enthusiasts in favour of vertical retorts, some who apparently think that we have almost reached finality; but here we have a practical gas engineer installing horizontal retorts and proving that it is very difficult to beat the performance of such horizontal retorts. I was rather impressed by the fact that he works his combustion chambers at a temperature of 1375° C. I have always been under the impression that a temperature higher than about 1250° C. was not particularly healthy for fireclay retorts; but apparently Mr. Clegg is able to work them at a much higher temperature, and, of course, the temperature is the critical factor. If you can get the necessary temperature in horizontal retorts, of course, you can get remarkable results. The analysis of the coke, given by Mr. Clegg, is also very good—there being only 7·5 p.ct. of ash—particularly when it is remembered that he is carbonizing a mixture of coals. I think he must be very fortunate in obtaining coal of exceptional purity. His use of exhaust steam is also very interesting, but I cannot quite understand why he uses a back pressure of 3 lbs. per sq. in. I am wondering how much that back pressure costs in live steam, because if you put the engines, pumps, &c., under back pressure you are doing it at the cost of live steam. There are several systems—such as the Nestor heater, for instance—which are providing heat with a minus pressure, acting almost like a condenser. At my own works we use exhaust steam very extensively for heating—for providing the hot water supply to the works, lavatories, and that sort of thing, and indeed, for almost every conceivable purpose. I should like to know, however, what type of oil separator Mr. Clegg uses, because one cannot use condensed steam from ordinary pumps or ordinary engines unless one has a very efficient method of extracting oil, and I have always found the oil extraction to be rather a difficult problem. It is done on board ship quite successfully, we know, but the conditions there are very different from those on a gas-works.

Mr. Clegg is to be congratulated upon the successful termination of as many as 120 contracts, and with 82 different contractors. I think he must be a diplomat of the first order.

With regard to the portion of the paper dealing with coke-oven gas, I should like to point out that Mr. Clegg has had to spend £47,000 in order to take and make use of that gas. With regard to the working results, the high thermal yield which Mr. Clegg obtains—viz., 75·9 therms per ton—the corresponding make being 15,987 c.ft. of gas having a calorific value of 475 B.Th.U. per c.ft.—is very remarkable. I appreciate that this paper is a description of new works, but it would be very interesting to have an analysis of the gas, showing the inert content. I do not wish to introduce a note of unpleasantness, but I rather wonder how such a remarkable yield of straight coal gas can be obtained without any steaming. It is an achievement which is very seldom exceeded in very good vertical retort practice with the use of such steam as we are able to decompose. The cost per therm into holder is also very low—2·1d. per therm. I see that the selling price of gas in Burnley is very low, being only 7d. per therm, and subject to rather heavy discounts.

I think Mr. Clegg is to be congratulated upon his very bold policy of scrapping plant with which he was not satisfied. The proof of the pudding is in the eating; after having done all this, he is enjoying the benefits of a completely new and most efficient plant, and his capital expenditure is only £374 per million c.ft. I do not think that anything further requires to be said to commend the bold policy which Mr. Clegg has adopted.

A BOLD POLICY.

Mr. R. E. GIBSON (Liverpool): I think we all very much appreciate the great trouble that Mr. Clegg has devoted to the preparation of this paper. The very full and detailed information he has given, not only with regard to the design and construction of the plant, but also with regard to capital costs, working results, working costs, and maintenance charges, will be of the utmost value to the members of this Institution. As the President has said, those responsible for the Burnley gas undertaking are to be congratulated upon the bold policy adopted in scrapping an unsatisfactory works and building new works; the greatly improved financial results obtained thereby provide direct evidence of the wisdom of that policy. It is interesting to note that Mr. Clegg and his predecessor, Mr. Leather, have pinned their faith to horizontal retorts and separate water gas plant. The results obtained are remarkable, as the President has said. With regard to the make per ton, and the therms produced, I should like to know whether the author has made any correction for moisture or ash in arriving at his figures.

An interesting feature in connection with the construction of the works is that advantage has been taken of a grant from the Unemployment Grants Committee. As one who has fought shy of the help of the Grants Committee,

I should rather like to know whether the conditions imposed by that Committee were such as to increase the capital cost beyond what it would have been if there had been no limitations.

The part of the paper which is of the greatest interest to me is that dealing with coke. As you know, I have been much interested in the quality of coke, and particularly the production of dry coke. With regard to the dry cooling of coke, it may interest the members to know that at Liverpool we have installed recently a Sulzer plant of an improved and simplified design. The plant at Burnley and at Glasgow consists of means for transporting the hot coke to the foot of the hoist; the hot coke is then hoisted to a great height and dropped by gravity into a large cooling chamber, which is connected by means of pipes to a waste-heat boiler. Thus, the hot coke has to be handled to a considerable extent. At Liverpool we have dispensed with the hoist and the separate cooling chamber. The hot coke from the retorts is placed in a container of special construction, which is moved on a roller track directly into a combined cooling chamber and boiler, having a tightly-fitting door. It is left therefore 80 minutes, the door being closed. A fan is put to work, and the inert gases in the chamber are circulated through the hot coke in the container and around the water tubes of the boiler. At the end of the period of 80 minutes the door is opened, the container is withdrawn, the coke having been cooled, of course, without any moisture. This plant has been working on a range of 96 retorts since last January, and it has worked very well indeed. We have had no trouble, except with an electrical telpher. The steam guaranteed was 780 lbs. per ton of coke, and that has been greatly exceeded; we have about 1000 lbs. per ton of coke. This plant provides a means of producing perfectly cool coke in a very satisfactory manner, and the coke is perfectly dry. In order to enable us to scavenge the chamber in the event of there being an excess of volatile matter, a pipe was fixed from the main flue of the retort bench to the inlet of the fan, and another pipe from the outlet of the fan to the atmosphere. In practice, however, it was found to be unnecessary, as the plant dealt successfully with coke containing a considerable amount of volatile matter. It was found that even "black ends" could be placed in the chamber without causing trouble, although probably that practice was undesirable.

Dust Interception on Water Gas Plant.

With regard to the water gas plant at Burnley, two different methods of intercepting the dust at the blast outlets have been installed. I believe that when Mr. Clegg has had longer experience with these two methods he will come to the conclusion that the dry method is the more satisfactory from the point of view of maintenance. We in Liverpool have found it so, and have done away with the wet method entirely.

I notice that Mr. Clegg has adopted steel pipes with welded joints for a length of five miles for the conveyance of coke oven gas. It is unfortunate that a real trial of the service given by steel pipes occupies a lifetime; if Mr. Clegg will be able to give us the benefit of his experience 30 or 40 years hence it will be very useful. I should like to ask whether the welded joints are plain butt joints, or socketed as well as welded.

I notice that he uses a steam crane in connection with the storage of coal, but how far the installation of machinery for storing coal can be justified is a problem. We should as much as possible avoid storing coal and putting it into stock and taking it out again; but, of course, it would not be safe to do without storage. At Liverpool we have used a steam crane to a considerable extent, but in conjunction with a high-level gantry on which the crane runs. By that means a very large capacity for storage can be provided, and by means of a grab the coal can be handled at low cost; the installation is simple, and its cost is fairly low. Finally, I should like to express my thanks to Mr. Clegg for his very useful paper.

Mr. E. L. Nicholas (Guildford): Some two years ago it was necessary to extend the carbonizing plant at my works, and I recommended to my Directors that the Congdon principle should be adopted. That was done, and I can bear out all that Mr. Clegg has said about the Congdon principle. Our results are probably not quite so good as his, but they are definitely better than the results we obtained before, with the ordinary type of horizontal retorts and ascension pipes. The cleanliness and efficiency generally of the two installations are not to be compared. But I experienced one little difficulty, which I had thought was local, until I noted the remarks of Mr. Clegg in that part of the paper dealing with condensers. Until two years ago our condensers at Guildford were quite adequate for dealing with the gas made in the retort house. By some strange circumstance, however, when we shut down the old retorts and used the new ones only we found that the condensers were not quite so good as they were before. I have since been considering whether, as Mr. Clegg suggests in his case, the Congdon scrubber standpipes are in some measure accountable. If he could give us some reasons for his suspicions I should be very grateful. I am wondering whether the trouble might be due to the heat of the liquor introduced into the Congdon standpipes. Has he considered the intervention of a cooler between the standpipes and the circulating tank? It occurs to me that if he had adopted that course—I do not know, but I am merely asking for information—he might have avoided the necessity for additional condensers. It is because I am in the same difficulty as he experienced that I should like further information.

The President: I am quite sure Mr. Clegg will understand that this is not a paper which is likely to promote a great deal of discussion. It is one which we shall all take home with us and ponder over, and some of us will do a little hard thinking. Perhaps Mr. Clegg would like to reply to the questions which have been raised.

The Author's Reply.

Mr. Clegg, replying to the discussion, said: With regard to labour costs, I consider that they are reasonably low. At the time at which it was necessary for us to decide whether horizontal or vertical retorts should be adopted, no evidence had been forthcoming that labour costs with vertical retorts were lower than the labour costs expected to be incurred when using horizontals, and even now the figures I have given at the conclusion of the paper will bear comparison with those relating to many vertical retort installations of capacity similar to that of the Burnley installation. Of course, labour costs represent only one item in the total cost of working the installation. I have tried to avoid discussion of the merits and demerits of verticals and horizontals, but I must say that the maintenance costs of verticals have proved to be such as to outweigh any disadvantage in regard to labour costs incurred in the working of horizontals.

Reference has been made by the President to the combustion chamber temperature of 1375° C. Such a temperature has usually been considered to be high, but I can assure the President that after three years working the chambers and settings are in a remarkably good condition, proving that high temperature has not been in any way detrimental to the apparent life of the settings.

As to the production of back pressure for exhaust steam heating, I am not familiar with the Nestor system, of which the President has spoken. Perhaps for small installations a vacuum system for internal heating could be used which would give a greater thermal efficiency than the back pressure system, but if it is being used for other purposes one would require, of course, to install sufficient plant for maintaining the necessary vacuum. I cannot give details of the construction of the oil extractor employed, but it is of the Worthington-Simpson pattern.

With regard to the yield of 75·9 therms per ton, although we use slacks and dank, the coal itself is of good quality, having a reasonably high volatile content, and, as will be seen from the analysis of the coke produced, it is remarkably low in ash. The figures given for 1929-30 have again been achieved in the year 1930-31, and if you would care to visit our works on some future occasion and endeavour to ascertain how it is done we shall give you a very hearty reception. Undoubtedly the fact that the installation is new is a contributory factor in the results obtained. The Congdon installation itself is undoubtedly having a great effect, and the fact that we burn off our coke exceedingly well for the Sulzer plant and use a high quality coal are other factors contributing towards the good yield.

A question has been asked by Mr. Gibson as to whether a correction was made for moisture or ash in arriving at the thermal yield. Was he referring to the coke?

Mr. Gibson: No; the coal.

Mr. Clegg: No correction is made in that respect. There is a correction made in the measurement of the gas from the temperature point of view, but no correction for moisture.

With regard to the grant from the Unemployment Grants Committee, a grant is very acceptable in itself, but the conditions imposed when a grant is obtained are in some cases onerous. My definite conclusion, however, is that where the installation is sufficiently large, and particularly where the majority of the work is to be done by contract and not by direct labour, it will undoubtedly pay to accept a grant. The amount of relief which we obtained in respect of this installation was very substantial, and most of the conditions and difficulties were thrown upon the contractors. It must be borne in mind that in the erection of gas-works plant conditions cannot always be carried out easily, and the Committee allow for consider-

able deviations from the conditions, in view of the skilled nature of the labour required for the construction and erection of most of the plant. A lot of the plant is delivered to the works already constructed.

A PIONEER.

I was very interested in Mr. Gibson's description of his coke-cooling plant, and I feel it is a compliment to Burnley that he should have installed such a plant. He is a pioneer, and has studied this matter exceedingly closely for many years. He has been very cautious in regard to the adoption of the plant to do the work on a large scale, and I am sure he will find, from the experience we have had during the past three years, that the dry-cooling of coke is a very important feature in the development of the coke sales market. The coke produced in that way is infinitely superior even to coke which has been quenched carefully, and the difference in the condition of the retort house and the surrounding plant, due to the absence of steam and sulphur-laden fumes, is remarkable. Mr. Gibson has profited by my experience and has not installed a hoist—not that I have anything against hoists in principle, or in their application to a Sulzer plant. We have to raise the coke by some means. As I have said, the only troubles we have experienced in the running of the new Oswald Street Works have been due to electrical faults, and troubles in connection with the hoist. Mr. Gibson has not installed an electrical hoist, but he has installed a telpher, which is also subject to electrical trouble.

With regard to the coke oven gas main, Mr. Gibson has said that the information which will be available 30 or 40 years hence as to the condition of that main will be interesting. I am told, however, that some of the steel mains in Burnley have been in use in the ground for 25 years; the exteriors of them are certainly in quite good condition, and the only trouble experienced internally has been the carrying forward of a fine dust formed by corrosion.

The steam crane was not installed for, and is not used for, the purpose of stocking coal, but only for the purpose of removing coal from stock, which is done very rarely. I have found the small crane very handy. Its capital cost is very low, and it can be used for oxide, ash, or pitch handling, or for any other purpose in any part of the works.

I should like to thank the President and Mr. Gibson for the very kind remarks they have made in respect to my humble contribution. I hope that it has been interesting to the members, and that the information contained therein will be useful to them. I should like to thank those who have taken part in the discussion.

Written Communications on the Various Papers

MR. THORMAN'S PAPER.

Mr. ARTHUR H. LYMN: May I, in the first place, add my very sincere appreciation of, and congratulation upon, the author's work in presenting this paper, which has been done in a very thorough and efficient form and should be of considerable value to the members? At the same time, it gives me great pleasure heartily to congratulate the builders of the plant at Southall which has given such admirable results.

As I have the privilege of directing the affairs of a firm of contractors which, with their "C.O.L." intermittent chambers, competes with the constructors of the Southall plant, it would ill become me to adopt the rôle of critic on this occasion; but fairness demands that, in making this remark, I should add that there is indeed very little for a competitor to criticize, when bearing in mind that designs naturally differ to some extent, and for such differences there are doubtless good grounds on both sides. Southall undoubtedly ranks among the best examples of intermittent chamber oven practice, and as such is much to be welcomed.

I had hoped that the operating results of a similar plant (of 5 million c.ft. capacity) completed last year by my firm for the Brentford Station of the Gas Light and Coke Company would have been available ere this, but unfortunately the works at Brentford (for which a second 5-million unit is now being constructed) has not yet commenced production. I hope the Gas Light and Coke Company will be equally kind in placing the results thereof at the disposal of the Institution.

The results obtained at Southall are of peculiar interest and very gratifying to me, because they are quite in line with certain results obtained elsewhere. As long ago as 1928 a paper was read before the Institute of Fuel (by Mr. N. J. Bowater) upon a test of Durham (Londonderry) coal, carried out in a "C.O.L." plant at Bremerhaven at my instigation, in which the Gas Light and Coke Company honoured us by taking part. Those results were looked upon askance by some engineers when reported, but I am glad to say that the plant, the subject of this paper, as well as others, has fully confirmed them. Moreover the results obtained in the "C.O.L." installation at Wandsworth, which has now been working for more than three years, were similar to those given in this paper, and were reported by Mr. Croft in the "GAS JOURNAL" under date July 31, 1929; and Mr. Carmichael, I understand, intends to inform the Institution either now or on some other occasion of the results he has obtained at Portsmouth with "C.O.L." chambers, which confirm Mr. Thorman's results in almost every particular, except that they were obtained at a carbonizing temperature of approximately 100° C. less.

One point is therefore outstanding—viz., that the system of carbonization known as intermittent vertical chambers is now an established success in this country, and engineers may install them with entire confidence for use with all kinds of coal.

OPERATION OF THE PLANT.

Having said so much on the general subject, perhaps I might make one or two remarks on the plant and its operation—*i.e.*, the subject of the paper. One of the most interesting parts of the paper is perhaps the application of the electrostatic detarring system. It certainly appears, from the particulars given, to work extremely well, and if not too costly should have an important future in this direction.

The author mentions that the method of construction—*i.e.*, without cambering the walls—enables uniform carbonization. Another system, to which I have referred, actually cambers the walls, for reasons which are claimed to be sound; and I think the author would agree that the carbonization therein is absolutely uniform.

Later on he refers to the use of water-cooled tie rods to avoid deflection of the buckstays. I would like to say that the author and other interested gas engineers have inspected plants where water-cooled tie rods do not exist; but they will all agree that the plants stand up to their work extremely well without them.

The combustion flue temperature adopted during this test was 1380°, which is practically 100° higher than is usually adopted in the other plants to which I have already referred. While it is clear that silica is a material suitable for still higher temperatures than this—and I for one would not object to utilizing the higher temperatures—it has been my experience that many engineers, including the two gentlemen already mentioned, object to going above 1300° C. Now it will be clear to you that 100° is an important factor in therm production as well as throughput, as, indeed, is shown in the author's paper.

This paper demonstrates a few points which have frequently been claimed elsewhere in reference to intermittent chambers generally, and I might draw attention to them—viz.:

Large gas make per unit of ground area.
Low labour costs.
Ease of scurfing.
Flexibility of plant.
Efficiency of steam decomposition.
Production of first-class road tar.
First-quality coke.

In connection with the last-mentioned point on the quality of coke, the author has given us a very valuable item of information under the heading "shatter test." Therein we find that with Durham coal the shatter tests on intermittents, continuous verticals, and horizontals are very close to each other, whereas with Yorkshire coals the intermittent vertical system shows marked superiority, being 64·6 as against 55 for continuous verticals. This is a very interesting and valuable piece of information.

I understand the President has asked Mr. Thorman for the moisture content of the quenched coke, and I should

be glad if he would amplify this by giving the volatile content.

Finally, I would like once more to congratulate both the author of the paper and the manufacturers of the plant, and at the same time to express appreciation of the benefit which the Gas Light and Coke Company confer upon the Industry generally by publishing the result of such an important piece of work.

Mr. C. S. SHAPLEY: Mr. Thorman is to be congratulated on his excellent paper, in which he shows the remarkable capabilities of a modern carbonizing plant. The paper will be of the utmost value to any gas engineer contemplating the installation of new carbonizing plant. The results obtained with intermittent vertical chambers at Southall are very good, and the tests carried out by Mr. Thorman to demonstrate the flexibility of the plant are particularly impressive. The low carbonizing wages are also noteworthy. No doubt it will be found expedient to work the chambers at reduced output during the summer months, rather than shut part of the plant down and so reduce its working life.

A FEW QUESTIONS.

There are a few points to which I would like to refer:

(1) The period between the scurfings of the chambers is very short—only 12 days. Has there been any spalling of the silica material in the chambers? It is generally agreed that spalling is associated with the scurfing operation, and it would appear that, with such frequent scurfings, the tendency to spalling will be increased.

(2) Although softened water is used, has there been any evidence of corrosion of the water-cooled tie-rods?

(3) Can Mr. Thorman give the electricity consumption of the electrostatic detarrers, also the capital cost per million c.ft. capacity, and also the back-pressure thrown by the plant?

(4) Although the plant is designed for the removal of the steam from coke quenching by means of the quenching towers, one would not expect the same freedom from the steam nuisance, and consequent corrosion of ironwork, as is obtained with a continuous vertical plant.

The plant is entirely mechanical, and the arrangements made for automatic operation are very complete; and it will be interesting to know at a later date how the repairs and maintenance charges compare with other types of carbonizing plant.

BREEZE FOR WATER GAS PRODUCTION.

Mr. G. M. GILL: There are several questions which I should like to ask Mr. Thorman.

He refers to the use of Venturi injectors on the producers for the purpose of employing inferior fuel. It would be a good step in advance if by such means it became practicable to consume breeze and small coke and so make available a larger quantity of coke for sale. I understand that at the Fuel Research Station, East Greenwich, steam jets have been employed with some success for increasing the draught and making possible the burning of coke breeze exclusively in the producer. In that case the producer is constructed with ample grate area which it would seem would be necessary to make it practicable to burn coke breeze. It would be interesting if Mr. Thorman would state whether he has so far carried out any tests with the Venturi injectors in action, and if so what have been the results.

Like the President, I was very interested in the use of water cooled tie-rods which most of us have at various times seen rendered inoperative by overheating.

One of the most interesting features of Mr. Thorman's paper is his description of the electrical precipitation process which has been adopted at Southall for the extraction of tar. This method of tar extraction has been successful for some years past in the United States, and in that country it deals with the extraction of tar from a very large quantity of gas. It is recognized that it is a highly efficient system, costing very little to operate, the main cost being the capital charges on the installation.

I should like to ask Mr. Thorman whether, so far as he knows, this is the first time that the process has been used for extracting tar from hot gas, which at Southall is stated to be 178° Fahr. at the inlet of the plant. It is very interesting that the process is so successful when dealing with gas of this temperature, and it should make it possible to work much more satisfactorily in gas-works situated in the tropics and in other warm countries where tar extraction is always a great difficulty.

A further point of interest in this connection is Mr. Thorman's statement that the coal gas tar extracted in this process is practically ready for use on roads without distillation and merely needs the addition of a small quantity of creosote oil to enable it to conform to the Road Tar Specification. The tar as extracted is stated to be very thick when cooled and needs to be heated for pumping. I should like to ask whether the addition of the creosote oil to the tar at the plant would enable the tar to be pumped readily.

FLEXIBILITY OF THE PLANT.

One of the most interesting matters contained in the paper is Mr. Thorman's statement that the carbonizing plant when working at about 60 p.ct. of its normal capacity is at least equally efficient in the important matter of the yield of coke for sale per ton of coal carbonized. It has been mainly this bogey which has prevented gas engineers from working their carbonizing plant at low capacity during summer months in preference to shutting down such portion as is not required. As would be expected the yield of gas per ton of coal is not affected by the reduced output of the plant, and it would appear that the only item of cost which is affected by working at low capacity is that of carbonizing wages, but this can be considered to be relatively unimportant, as the cost of carbonizing wages per therm in the summer months is always considerably higher, however the plant may be worked.

There is no gainsaying the fact that the policy of working carbonizing plant at low capacity during the summer months would greatly reduce the maintenance costs of any carbonizing plant and would proportionately increase its useful life. It is a well known fact that the life of coke ovens which are normally worked continuously is very considerably greater than that of retort plant in gas-works, due entirely, I think it can be said, to the continuous working. It is to be hoped that other engineers will experiment in the same direction and report their results for the benefit of other members.

In connection with this question I should like to ask Mr. Thorman why it is that radiation losses from the Southall settings when worked at a low capacity are not increased to such an extent per pound of producer fuel as to reduce appreciably the coke made for sale per ton of coal carbonized.

STEAM DECOMPOSITION.

Mr. Thorman's figures in regard to the steam decomposed in the ovens are interesting, and it would appear that the steam decomposition in the Southall ovens is considerably higher than that normally experienced in a carburetted water gas plant, which I believe I am right in saying is about 50 p.ct. of that theoretically required.

Mr. Thorman mentions that he is decomposing an average of about 76 p.ct. of the steam used in the ovens, which would seem to be in comparison a high figure, although it should be borne in mind that the passage of steam is considerably longer in a vertical oven than in a water gas generator. I should like some enlightenment of Mr. Thorman's method of arriving at the percentage of steam decomposed, as I do not understand the method which he briefly describes in his paper. I might state that an apparatus known as a "Steam Decomposition Meter" is sometimes used in the United States for showing continuously on a dial the amount of steam decomposed, and this apparatus would presumably be useful in a carbonizing plant where steaming is done.

In conclusion, I consider that this paper will be very useful to other gas engineers and will assist materially in the improvement of the science of coal carbonization.

CONVINCING THE MOST SCEPTICAL.

Mr. L. H. SENSICLE: Mr. Thorman's comprehensive paper should convince the most sceptical that intermittent vertical chambers have passed the experimental stage in this country, and are established as a sound and efficient system of carbonization. The process is however sufficiently novel to present wide and interesting fields for further study—a fact which Mr. Thorman has fully realized in collecting the valuable data presented in the paper. It is a matter for congratulation that so full a disclosure of the operating detail and results has been added to the general pool of knowledge, thus providing material which will be of value to the Gas Industry as a whole.

One of the outstanding features of intermittent vertical chambers is that they afford a very efficient means of water gas production. This remarkable efficiency has not been fully appreciated until recently, but Mr. Thorman's data are sufficient in themselves to demonstrate the fact. As he points out, one of the important reasons for the high efficiency of steam decomposition is the great depth of the coke bed, there being a column of about 20 ft. of glowing coke through which the reacting steam must pass. In view of a contention widely held that it does not pay to produce water gas within the carbonizing chamber as compared with generation in external water gas plant I should like to give two reasons which, as far as I know, have not previously

been mentioned, why water gas production in vertical chambers is definitely more efficient than in water gas plant, at least from the point of view of carbon balance.

The first reason is that in ordinary water gas generators the air supplied for the " blow " is not preheated—*i.e.*, the system is not recuperative—whereas the secondary air for combustion in vertical chamber flues is preheated in recuperators. Thus, although in the latter case heat for the water gas reaction is transmitted indirectly—*i.e.*, through the walls of the chamber—the coke consumed in the producers per 1000 c.ft. of water gas made is less than the coke consumed in the " blow " cycles of a water gas generator. A second, and less important, reason is that the coke in the reacting chamber is already heated to the necessary temperature after completion of carbonization in vertical chambers, the subsequent heat supplied being partially taken up by the endothermicity of the reaction and partly removed as sensible heat of the water gas and undecomposed steam. On the other hand, the reacting coke in external water gas plant has to be heated up from cold.

It is of interest to calculate the total coke consumed in chambers and producers per 1000 c.ft. of water gas in the three cases quoted in the paper—namely, for 2, 3, and 6 hours' steaming respectively. The result is approximately as follows:

	C.V. Assumed.	Total Coke per 1000 C.Ft. Water Gas.
2 hours' steaming . . .	300 ..	27·7 lbs.
3 ,, ,, . . .	290 ..	26·83 ,,
6 ,, ,, . . .	290 ..	28·06 ,,

The above figures are better than those usual for blue gas production in external water gas plant.

Breeze Made in Vertical Chambers.

The data given for coke and breeze made are interesting, and as regards yield of the latter, while the figure of about 1 cwt. per ton of coal carbonized might be considered satisfactorily low, experience elsewhere leads to the conclusion that breeze made in vertical chambers need not exceed 3 p.ct. The reason for the higher breeze production at Southall probably lies in the use of small coke instead of breeze as a protective pad on the doors. When breeze is employed for this purpose some of it becomes incorporated with the charge owing to contact with tarry matter released from the coal during carbonization and the subsequent binding together of such breeze when this tarry matter hardens. I am in a position to say, further, that in the case I have in mind no advantage was found in the use of small coke as a substitute for breeze, this, however, being contrary to Mr. Thorman's experience. I would like to ask whether the bulk density figures given for chamber and other cokes were all obtained on perfectly dry coke as this is a very necessary precaution to take. Mr. Thorman's figures for vertical chamber, and horizontal and continuous vertical retort cokes respectively are equivalent to 21·35, 24·36, and 28·75 hectolitres per ton, the latter figure being particularly good for continuous vertical coke, which would presumably be drier than the others. It is a well-known fact that coke with only 4 p.ct. water is reduced in bulk density by 1 hectolitre per ton on that account. As regards the shatter test figures, it would be interesting to know whether any figures were obtained by the British standard method in which 2 in. and 1½ in. square mesh screens are used. These standards have been set after much careful research by the various coke research committees, and figures so obtained have the value of being comparable with those found elsewhere.

I am particularly interested in the proposal to use the tar separated at the electrostatic tar extractors for road purposes without distillation, but presumably after dehydration. Mr. Thorman proposes to use creosote oil for purposes of adjusting viscosity, &c., but I would suggest that there is a light oil condensed in the coolers which should be collected in trays and allowed to stand. Naphthalene will be deposited, and the supernatant oil can be run off and used as the necessary diluent for the road tar. Furthermore, dehydration of the tar can be effected by agitating the tar with compressed air at 60° C., while the dilution and addition of bitumen are performed. It is perhaps necessary for me to add that I ventured to obtain patents about six years ago for this process after finding it suitable in practice, a further interesting fact being that the tar so made is lower in phenols and naphthalene than that produced by distillation methods.

In conclusion, may I add my congratulations on the excellent results reported in the paper which have evidently exceeded in unexpected degree the results anticipated by some of the guarantees. The last paragraph of the paper sums up the position admirably and should be mentally underlined.

Intensive Liquor Circulation.

Mr. A. G. Grant: Descriptively this paper is one of very great interest, but in addition, the very high technical value of the results and figures cited cannot be overemphasized, as the plant has been designed with unusually liberal arrangements for quantitative measurement at all points; in fact it represents a nearer approach to the ideal plant of the chemical engineer—a plant in which every quantity and physical state can be measured at every stage of the process.

The introduction into modern carbonizing practice of a system of intensive liquor circulation has done much towards eliminating troubles which were previously almost insuperable, and in this connection the precautions taken on the plant at Southall are of great interest. The result of this practice, however, is that an enormously increased load is placed on the condensing plant, as the gas leaves the retort house saturated at 180° Fahr. instead of the temperature of 160° Fahr. obtaining in systems with little or no liquor spraying. The difference between 160° and 180° Fahr. (saturated) represents an increased heat content of over 100 p.ct., this additional amount of heat being abstracted from the retort house and delivered to the condensers, necessitating a greatly increased cooling surface in the latter plant. In addition, small changes in the temperature of saturated gas in this higher range produce relatively large heat and volume changes, with consequent increase in the difficulty of effecting uniform governing and condensing. This aspect of the effect of liquor circulation in retort and coke oven systems is extremely important in the consideration of condensing problems. I wonder if cooling of the circulating liquor would affect this question materially. Probably the resulting lower gas temperature would enable the author to produce a road tar requiring no thinning in his detarrers.

The very positive separation of tar and liquor by the detarrers must be most gratifying to the author. Has he found, however, that the effect on the primary liquor has been on the whole a beneficial one, or has the result been a decrease in higher tar acid content and an increase in phenol content, as was found at Hinckley? Apparently the makers of the detarrers have departed from their usual oil sealed lead, in arrangement, and have installed pin insulators in semi-external chambers. Has trouble been experienced from the cooling of these chambers and the deposition of moisture in the insulators, or have some heating precautions been taken? A disadvantage of this arrangement appears to be that the detarrer must be by-passed completely when the top electrode gear is cleaned. Will the author explain how often this has to be done?

Referring to tar extraction efficiency, I think this should be considered in relation to the actual tar fog content of the gas. In dealing with gas containing 4000 grains per 100 c.ft. it is a very easy matter to remove the first 3500 grains which are held in the gas stream mainly by turbulence—in fact an ordinary condenser should reduce the content to 200 grains and then have a so-called efficiency of 95 p.ct. It seems to me that the ultimate criterion is the number of grains left in the gas, and from this point of view, the figure given of 2·5 grains is extraordinarily good, whereas the figure of 99·7 p.ct. efficiency has only a small significance.

Carbonizing Durham Coals.

Mr. J. Kirkhope: Mr. Thorman's extremely interesting paper is essentially such a recommendation to gas engineers to install intermittent vertical chambers that it might almost be considered a carping criticism to refer to his remark in which he states that the Gas Light and Coke Company have installed in recent years continuous vertical retorts in which Durham coal is efficiently carbonized.

It all hangs on what is included in the word " efficiently." Highly swelling coals such as Durham and other varieties are notoriously extremely difficult to carbonize in continuous vertical retorts, and I feel satisfied that it is for this reason that gas engineers are looking again to the intermittent carbonizing system as a solution of their difficulties in connection with these coals.

Being interested in all systems of intermittent vertical chamber plant, I am naturally extremely interested in the excellent results obtained at Southall; but I wish to break a lance with Mr. Thorman where he speaks of the method of construction ensuring maximum strength of the chambers without the necessity of cambering the side walls. It is perfectly obvious that a slightly cambered side wall, when supported laterally, must essentially be of stronger construction than a rectangular side wall; and the suggestion that the absence of cambering ensures uniform carbonization across the whole width of the charge is not borne out by experience, as I am acquainted with chambers built

with a slight camber, for the specific object of providing greater strength, which show equally uniform carbonization. Actually, of course, in the horizontal heating flues a camber in the chamber provides a slight restriction in the flue in the middle of its horizontal length, and the increased velocity of the gases at this point provides quicker heat transference to the thicker charge at that point.

Another point to which Mr. Thorman refers in the construction of the setting bracing is the use of water-cooled tie rods. Water-cooled tie rods have been employed in the past in plants with which I am acquainted, but their advantage proved to be illusory; indeed, there is always the risk with water-cooled tie rods that in the event of a failure of the water supply, fracture or damage may occur to the tubes, with resultant weakening of the bracing and leakage of water into the setting. For this reason these plants to which I refer have been for years deliberately designed without water-cooled tie rods, the ties being placed at positions where they are least likely to be subjected to heat. I cannot, therefore, accept Mr. Thorman's suggestion that these water-cooled tie rods obviate deflection of the buckstays and prevent deformation of the chambers. Clearly the silica chambers have to expand; and whether they are held by water-cooled tie rods or not, the conditions governing their expansions and preventing deformation are the same—*i.e.*, correctly designed bracing, in which, of course, I include the tie rods.

I note from Mr. Thorman's paper and the figures given therein that the average temperature difference between the top and the bottom combustion flues is 350°-400° C., which strikes me as a very big difference considering the comparatively small difference between the minor axis of the charge at the top and at the bottom, and suggests that the coal charge is not perhaps so uniformly carbonized as Mr. Thorman claims. It would be interesting to know what the volatile content of the coke is, and, if possible, the difference in the volatile content of the coke from the top of the charge and from the bottom of the charge.

The heating system of another well-known type of intermittent vertical chamber plant provides a number of burners situated one above the other, to enable combustion of the heating gas to be carried out progressively, with the result that one is able to obtain a smaller temperature difference between the flue gas at the bottom and at the top, or, given the same bottom temperature, a higher mean temperature. Putting this in another way, one is able to obtain the same temperature in the flue gases leaving the chambers at the top with a lower maximum temperature in the bottom combustion flues; and, indeed, in a test recently carried out, the guaranteed throughput was easily achieved. During a period of 7 days, 88·9 therms of 471 B.Th.U. gas was obtained from Durham coals, while the temperature at the bottom was 1301° and at the top 1016°, a maximum flue temperature of about 90° C. less than at Southall.

With reference to the gas analysis given by Mr. Thorman, it would be interesting to know whether this refers to the gas leaving the carbonizing plant or after purification. The nitrogen content of 5·4 p.ct. during the guarantee test is so low that it must be assumed that this is the analysis prior to purification, or before admission of air to the purifiers. With reference to the bottom gas offtakes, I shall be glad to know what seal Mr. Thorman finds necessary to employ in order to avoid undue pressure in the chamber.

Mr. Thorman says that the producers have proved capable of gasifying over 5 tons of coke per 24 hours each, this being over 10 lbs. per hour per sq. ft. of grate area. According to the actual fuel gasified per ton of coal carbonized, it would appear that the producers have actually gasified up to 6·7 tons per 24 hours each, equivalent to 13 lbs. per hour per sq. ft. of grate area calculated proportionately. Perhaps Mr. Thorman would be good enough to confirm this, as 10 lbs. per hour per sq. ft. of grate area is certainly a very low figure.

The amount of steam raised per lb. of dry fuel fell below the contractor's expectations, being 2·45 lbs. as against 2·73 lbs. guaranteed. Is this due to loss of heat from the waste-gas flues, which appear to run for about 300 ft. along three sides of the setting? It would be interesting to know the waste-gas temperature at the outlet of the settings and at the inlet of the waste-heat boilers.

Further information as to the way in which steam decomposition is obtained would be interesting; in test No. 5, where 18·8 p.ct. of steam was utilized, it is stated that 46 p.ct. was decomposed. Allowing only 2·8 therms per p.ct. of steam, this would suggest that 24·2 therms of water gas were generated. As 91·9 therms of mixed gas were obtained per ton of basic coal, this would suggest that only 67·7 therms of straight coal gas were obtained per ton of basic coal—a figure which is difficult to reconcile with Mr. Thorman's results for test No. 1, where 76·5 therms of mixed gas were obtained per ton of basic coal when employing 3·1 p.ct. of steam, 68·5 p.ct. of which was decomposed.

DR. SCHÜTTE'S PAPER.

Mr. G. M. GILL: Dr. Schütte introduces several matters of importance in connection with modern gas distribution. He explains the various means by which consumers can be adequately and uniformly supplied with gas, and he describes in some detail a method commonly adopted in Germany—namely, that of installing service governors for each consumer. This system has undoubted advantages, and it can be said that the initial cost of the governors is likely to be recouped partly, or even wholly in some cases, by the saving in additional or larger mains, or in the alteration of mains for the better supply of various districts.

The installation of service governors provides excellent facilities for increasing the pressure throughout the district by the comparatively few inches which in most cases are necessary at peak load times to give every consumer sufficient gas. There is no doubt also that the provision of service governors has the effect of giving many consumers a better supply while at the same time it prevents excessive pressures to many other consumers.

Dr. Schütte made brief reference to the system which finds universal acceptance in the United States—namely, that of laying a system of loop mains, each loop containing an area of (say) one square mile. Accordingly, large towns have a considerable number of such loops all interconnected and supplied with gas at medium pressures, normally of 1-10 lbs., with lower pressures during the hours of small consumption.

Each loop is connected to the low-pressure grid work of distribution mains within its area by governors at two or more places at which points the pressure is reduced to 4 or 5 in. By this means the whole low-pressure grid within each loop is maintained at a very uniform pressure. Should any part of such low-pressure area be shown to be deficient in pressure, it is merely necessary to add another governor at such point. These series of loops form an excellent foundation upon which to build up the adequate supply of large areas in whichever direction the town may grow.

In many cases in the United States this loop system has been developed gradually by isolating the ordinary trunk mains and connecting these together to form loops. All branch mains and consumers' services are then disconnected from the loop mains thus formed, and the necessary alterations are made within each loop to form an adequate low-pressure grid for the supply of all the consumers in the loop through two or more points of contact only with the loop main. It would seem to me that the adequate supply of the district is best made either by the provision of service governors to all consumers or the institution of the loop main system, whichever is the better adapted for the particular situation.

Dr. Schütte describes the developments which have taken place in meter design in Germany. His views are very interesting. In this country it has been found necessary to concentrate, if trouble is to be avoided from meters, upon the exchange, testing and repair or replacement of all old and defective meters and to ensure that meters are of sufficiently large capacity to deal with the peak load requirements of each consumer. Further, considerable advantage has accrued from the use of semi-chrome tanned meter diaphragms which are now widely used in this country. A point of great importance in the avoidance of meter troubles has undoubtedly been the supply of a good quality of gas, reasonably free from corrosive constituents, and in this direction the introduction of the therm system has undoubtedly had a good effect.

Dr. Schütte includes an illustration and makes some reference to the Brandl-Marischka meter, which is a comparatively new and very interesting development. This type of meter, which I have myself seen at work and under construction, is undoubtedly destined to become extensively used in the future.

In the latter part of his paper Dr. Schütte refers to rust and dust deposits in mains. The amount of trouble experienced in this direction undoubtedly varies for the most part with the purity of the gas supplied, and in this connection I would like to call attention to the excellent reports issued during the years 1916-1923 by the Institution of Gas Engineers Committee on the Life of Gas Meters. In these reports it is shown that hydrocyanic acid and carbon bisulphide, in combination with ammonia, oxygen, carbon dioxide, and sulphur dioxide in the gas supplied, are corrosive agents in the presence of moisture; but if there is an absence of moisture the same corrosive constituents are rendered practically harmless, and it would seem therefore that the best precaution against the production of rust and dust deposits would be to extract the moisture which causes the trouble. This has been done with success by many British gas undertakings and would seem to be the surest means of avoiding trouble in this direction. On the other hand, it would seem to me from past experience that if no ammonia is allowed to find its

way into the district, and if the oxygen content in the gas is maintained at a low figure of (say) not more than 0·3 p.ct., the amount of trouble caused by rust and dust in mains and services is not likely to be serious.

Dr. Schütte's paper is a very welcome addition to the records of the Institution, especially as it comes from a gas engineer of high repute in Germany.

DR. LESSING'S PAPER.

Mr. G. M. GILL: In Mr. C. E. Paige's eloquent address in presenting his paper on "The Gas Industry in America" he stated that it was more important to provide for future than for present competition, and I think that it can be said that Dr. Lessing's paper deals with a subject which undoubtedly falls within the scope of matters which urgently require attention if we are to provide adequately for future competition.

In his paper Dr. Lessing states that coke as supplied by gas undertakings normally contains an ash percentage of 12 to 15 p.ct., while some coke contains an even higher quantity. This is admittedly a high figure, but it undoubtedly closely approximates the truth, especially when we remember that coke must inevitably contain 50 p.ct. more ash than the coal from which it was made.

Dr. Lessing states that the bulk of British coals have an inherent ash content of from 1½ p.ct. to 3 p.ct., which means that the remaining ash content is removable, presumably without first crushing the coal before cleaning. Accordingly it would seem that it is only necessary to clean the coal to enable us to produce a coke containing from 2·2 p.ct. to 4·5 p.ct. of ash.

It is my belief that the Gas Industry would derive great benefit from the sale of such coke, for it would raise this fuel to the same grade as the high-class Welsh and anthracite coals which in normal times fetch very high prices. There is no gainsaying the fact that the coke market of the future depends very largely on its quality. If its quality could be transformed in the manner described by Dr. Lessing the Gas Industry would derive the greatest possible benefit. This subject so strongly advocated by Dr. Lessing is clearly one which should have our active co-operation.

As was pointed out in the paper, such substantial improvements in coke quality would have a marked effect on gas-works results, not only in a retort house, but also in a water gas plant; and while Dr. Lessing's estimates of resulting benefits caused some criticism, I should myself anticipate that the direct and indirect benefits from clean coal and coke with very low ash content would be substantial enough to reproduce the savings anticipated by Dr. Lessing. In this connection it must be borne in mind that increased output per unit of plant, as would be obtained by the improved quality of coal and coke, always carries with it savings in costs in many directions.

I was interested to learn during last winter in the United States that the Koppers Company have been able to bring about a great improvement in the receipts from the sale of coke in the gas companies which they own or control, as a result of their obtaining also control of the collieries supplying such companies. By this means they have been able to make substantial improvements in quality of coal and coke with great advantage to the gas companies in question.

It is clear that the proper situation for coal cleaning plant is at the colliery, but owing to political interference and other troubles the coal industry is not now well placed for financing the installation of new plant, and it would therefore seem important, if much is to be done with this important development, that the gas companies should consider the possibility of jointly assisting in the financing of coal-cleaning plant.

CHLORINE CONTENT OF COAL.

Mr. W. A. DAMON (Chief Inspector of Alkali Works): The question of the chlorine content of coal and its distribution in the products of carbonization is one which has been interesting the Alkali Department for some time. The examination of a number of samples of typical coals has shown chlorine contents ranging up to 0·36 p.ct. (66th Report on Alkali, &c., Works). The proportion of water-soluble chlorine in coal slacks from the same seam increases markedly as the size of the slack diminishes. Apart from the effect on retorts and furnace linings, a high chlorine content in coal is reflected in the ammonium chloride content of the tar produced from it with consequent ill effects on tar stills. The experience of tar distillers has shown that even so low an amount of ammonium chloride in the tar as 0·1 p.ct. is above the limit compatible with longevity of tar stills. In the recently published 67th Alkali Report the results of an investigation into the causes of tar still corrosion are published, which show that this amount is often exceeded, and which show clearly that the observed corrosion of tar stills is mainly due to the presence in the tar of ammonium chloride. The general application of a system of pre-treatment of coal which results in a considerable diminution of the chlorine content should result in a greatly reduced rate of corrosion of tar stills.

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In the course of further discussion it was stated that the Council of the Association was concerned first to establish the principle of periodic re-verification, rather than to state a definite period. The question was also raised as to whose responsibility it should be to ensure that re-verification was carried out; and it was suggested that the onus be placed upon the gas undertakers.

A resolution was put forward expressing the view that ten years should be the maximum period during which a meter should be allowed to work without re-verification. This was not intended to bind the Association to a period of ten years, but merely stated that period as a maximum.

There was further discussion as to the manner in which the machinery for effecting periodic re-verification could be put into operation and who should take the responsbility; it was again pointed out that the Association were anxious first to establish the principle, and to obtain the support of other bodies, so that they could make representations to the Deputy-Warden and thus give him the opportunity to take the necessary action. The necessary machinery could be arrived at by joint discussions between all the bodies concerned.

Finally, it was decided that the Hon. Secretary of the Association should write to the local authorities and the Association of Municipal Corporations asking them to support or oppose the movement for periodic re-verification, and to send their decisions to the Deputy-Warden of Standards. It was agreed that at this stage no particular period should be mentioned.

The meeting appointed Mr. William Gordon (Edinburgh), Mr. Winterbottom (Manchester), Mr. Nott (London County Council), and the Hon. Secretary to represent the Association at the meetings with other bodies concerned, to discuss the matter. The following were also elected to represent the administrative authorities: Mr. C. Chambers, J.P. (Birmingham), Mr. H. N. Barrow, J.P. (Manchester), Bailie Given (Edinburgh), and the Chief Officer of the London County Council.

Absorption of Pressure.

The Council's Report stated, in connection with this matter, that the Board of Trade, together with the members of the Council, had felt the desirability of general agreement as to air being the single standard for the purposes of this test, but there had been certain difficulties to contend with in dealing with certain classes of "high capacity" meter produced and sent out upon the districts during the transition period from "standard" meters to the present day "high capacity" meter. A large number of these meters—representing a large capital outlay—had been stamped under the Act as being within the limits of tolerance when gas was used, but which would certainly have been rejected had air been the obligatory standard medium. In framing an amendment, therefore, it was necessary to bear these meters in mind against the time when they came along for re-verification. In order to get down to a single standard in place of the existing dual standard of "gas or air," it was necessary to consider the most practical means of carrying this into effect; in brief, whether, during a limited period—which the Board would fix—it would be better to continue the dual standard for existing meters, permitting gas to be used and maintaining the existing limits of tolerance, or whether it would be better practice to secure air as the standard right away, with an additional tolerance for existing meters of the appropriate type.

The Council, having examined this question very carefully, were convinced that the latter proposal was the better method of the two. To that end, therefore, they recommended that the meeting should authorize the following proposal to be submitted to the Board of Trade—viz.:

> That air be fixed as the standard medium for this test. That the existing limits of tolerance be maintained, excepting and provided that if, in the opinion of an inspector, a meter stamped before 19 is of such construction that it cannot reasonably be expected to satisfy the requirements of the regulations, he may in the exercise of his discretion stamp such a meter which does not exceed an additional tolerance of two-tenths in each case of the tolerance already provided for.

Mr. Nott (London County Council) proposed the amendment of the resolution to provide that gas should be fixed as the medium for the test.

Mr. Barry (London County Council), who seconded, urged that the best medium for the absorption test was gas. Some inspectors had not as much experience as others, and where an inspector was in doubt as to the absorption of any particular meter, he should test it with gas before he rejected it. It did not cost very much to test with gas, and the test was very definite. If gas was used there would be no need for the suggested additional tolerance. It would not give rise to objections from the gas companies or the meter makers, and it would not result in under-rating. He supposed that an objection to the use of gas was the fear of a reduction of output, but in his view that fear was groundless. The only real objection he could think of was that the gas test occupied a little longer time than the air test, and that it gave a little trouble; but was that a legitimate reason for rejecting the use of gas? His view was that it was not. He hoped no one would suggest that the use of gas was dangerous. Every meter had had gas passing through it before the meter inspectors received it, and there might be gas in it when they did receive it. He urged that an inspector should not reject a meter unless the absorption exceeded five-tenths when using gas.

A Speaker referred to a letter from the Board of Trade, dated Dec. 24 last, advising inspectors to use air as the standard medium for testing, and to reject all meters that did not come within the limits when so tested. On the other hand, a manufacturer in his area had stated recently that he had wanted some meters tested, but he felt sure that they would not be passed locally, because they would be tested with air, and they would be found to absorb too much. Therefore, he had decided to have them tested elsewhere. That action was detrimental to the testing authorities in that locality, and this was a reason why there should be uniformity as to the medium of test. The speaker urged that the Board of Trade letter should be treated as a definite instruction. He did not support the Council's suggestion that there should be an additional tolerance of two-tenths at the discretion of an inspector.

Mr. Alfred E. Watson (Sheffield) said it seemed, from the recommendations made, that the members of the Association were more anxious to safeguard the interests of the gas undertakers and meter manufacturers than the interests of the consumers. His experience as an inspector of weights and measures had been that if the manufacturer and repairer were held to narrow limits they would produce a better instrument than they otherwise would do, and the same argument seemed to apply to gas meters. In this connection he said that before the 1920 regulations were passed, a certain authority had not had its meters stamped at all. After the passing of those regulations, however, that authority had been brought into line and began to submit its meters for verification; and it was quite common for such meters to be rejected as the result of the test for absorption. Then the manager of the gas undertaking had told repairers that in cases of rejection they would be mulcted in the verification fee. It was not very long, however, before there was an improvement, and it had now become quite a rare occurrence for a gas meter to absorb more than the limit of five-tenths; in 99 p.ct. of cases the absorption by three-light and five-light meters since that time had not exceeded one-tenth. He agreed that air was a satisfactory medium for the test, but in his view there was not the slightest necessity for any increase of tolerance, whether the medium of test be gas or air.

Mr. Nott (London County Council), referring to the Board of Trade letter of Dec. 24, said it had been stated by the Permanent Secretary to the Board of Trade that it was merely an expression of opinion.

Mr. W. Gordon (Chairman of the Association) said the letter stated that the Department were of opinion that air was the better medium, apart from economic considerations. In his view that was a fairly good lead.

The Secretary pointed out that the Council, in suggesting the additional tolerance, had had in mind the high-capacity type of meter produced during a period of transition from the "Standard" meters to the present-day "high-capacity" meters. At the same time, the loss of five-tenths pressure through the meter was a serious item to gas engineers, apart from the question of wear and tear. His experience, and that of the inspectors of the London County Council, was that meters could be, and were, produced having a less pressure loss than that of the old standard type of meter with an equal size case. Therefore, it was well to have a single standard, but, inasmuch as certain manufacturers were still pursuing their experiments, the best way of dealing with the matter would be to provide for an additional tolerance at the discretion of the inspector in respect of such meters.

Mr. F. Coe (Nottingham) said he did not think anybody would dispute the opinion expressed by the Board of Trade, but the regulations did provide for the use of either gas or air, and the London County Council inspectors appeared quite justified in the course they had pursued. At the same time, while one authority worked to one standard and another to another standard, business was diverted, as had already been suggested, and it was desirable, therefore, that there should be one definite working standard applying to all.

Mr. S. B. Langlands (Glasgow) said he gathered that the Council desired to make a pious recommendation as to the means of improving an extraordinary condition. He agreed with the Board of Trade that air was preferable to gas as a standard for the test. To give point to this view, he said that recently he had been trying some fixed nipples for the flow of gas, using a specially hard metal, but the results of gas tests in Glasgow and in Edinburgh varied, owing to the variation in the specific gravity of the gas in those two places. If air had been used as the medium for the test, there would have been no trouble.

After further discussion, Mr. Nott's amendment, to the effect that gas be recommended to the Board of Trade as a standard medium for the test, was put to the meeting and lost.

A motion by Mr. Watson, to the effect that the Board of Trade be asked to rule that air should be used as the standard medium for the test, was seconded and agreed to.

The second part of the Council's recommendations, to the effect that the extra tolerance of two-tenths be allowed at the discretion of the inspector, was further discussed. Mr. Watson was not satisfied that the increased tolerance was necessary. Mr. William Gordon (Chairman of the Association), on the other hand, pointed out that regard

must be had to the capital value of the meters which were already in use, having been passed by Inspectors, but which would not meet the new conditions. Therefore, an inspector should have power to use his discretion to the extent of a further two-tenths. Mr. E. M. Foster (Exeter) also urged that the question must be considered in conjunction with that of periodic re-verification, and that it was necessary to make an allowance for meters already stamped. That principle was applied in regard to weights and measures.

In order to ensure fairness to meter makers and to gas undertakers, as well as consumers, Mr. Gordon moved that the extra tolerance of two-tenths be allowed at the discretion of the inspector, as recommended by the Council.

An amendment was moved by Mr. S. B. Langlands (Glasgow), and seconded by Mr. Colbourn (Birmingham), however, that there should be no alteration to the existing tolerances.

The amendment was put to the meeting, and lost by 18 votes to 14.

The Marking of Meters.

Without retracting in any way from the position of desiring the statuory details being incorporated on the dial plate, the Council were unanimous in recommending that, if metal capacity badges were to continue in use, provision should be made to seal them, in order to prevent alteration or substitution after a meter had been stamped. The principal objection to a separate seal for the purpose was the consideration as to whether such a seal would render a meter still a legal measure when the usual seals enclosing the registering mechanism were broken. The Council asked for suggestions as to how best its proposal could be carried into effect.

Mr. Watson moved that the Board of Trade be asked to amend the regulations by providing that meters having more than one seal broken should be deemed to be unstamped. He pointed out that there was a precedent for this in the Liquid Fuel and Lubricating Oil Regulations, where it was provided that an instrument on which a seal was broken was deemed to be unstamped.

The resolution was seconded, and carried.

Stamping of Certificate Meters.

With regard to the practice of inspectors in dealing with meters submitted for test after a period of use on the district, and which were found to be correct, the Council's Report stated that whereas some inspectors released the meter with the original seal, many re-stamped the meter before releasing it for further service, at the same time logging the particulars of the original seal, so that, if necessary, the details of the original verification could be traced. Where the original seal was left—presuming it was in good order—there was at a later period nothing to indicate that the meter had been verified at a subsequent date to that indicated. Therefore, the Council—after taking the opinion of the Board of Trade—recommended, in the interests of uniformity, that all inspectors should re-stamp correct certificate meters.

This recommendation was agreed to, without discussion.

Revision of Regulations.

The final paragraph of the Council's Report stated the items upon which, from time to time, recommendations had been submitted to the Board of Trade and still remained to be dealt with. These related to new patterns and B.O.T. certificates, and power of entry into premises (in addition to the questions of periodical re-verification, absorption of pressure, and the marking of meters, already dealt with). Members were asked to bring to the notice of the Council any items in the regulations which they considered should be the subject of alteration or amendment.

The Stamping of Electricity Meters.

Mr. S. B. Langlands suggested that electricity meters should require to be tested and stamped, as was the case with gas meters, and he asked for the opinion of inspectors on that matter. It was his opinion that this matter would come very acutely before inspectors in the future, and he urged that the Council be given a watching brief and should be requested to report annually.

The importance of this matter was emphasized also by the President, who urged that all electricity meters should be tested. Mr. Gordon (Chairman of the Association) intimated that the Council was anxious that electricity meters should be treated in the same way as gas meters, and was awaiting developments.

Testing Meters for Outside Authorities.

A question was asked by a member as to whether an inspector of gas meters would be justified in refusing to accept for verification gas meters which belonged to a local authority other than his own, and which had not appointed an inspector of its own. It was pointed out to him that in most cases there was nothing in the regulations to prevent inspectors dealing with meters coming from outside their own areas.

Necessity for a Satisfactory Testing Dial.

Mr. Watson moved that the Council be instructed to consider the inclusion of the following recommendation in any proposals for the amendment of the regulations—that in the case of dry meters the small dial provided on the index for the purpose of the registration test shall consist of two concentric circles, and the extremity of the index finger shall traverse the space between such circles—*i.e.*, projecting beyond the inner, but not reaching the outer, circle. The width of that part of the index finger projecting beyond the inner circle shall not be greater than that of the sub-division marks.

He complained that in some cases the index fingers projected nearly a quarter of an inch beyond the outer circle, and that it was high time a satisfactory testing dial was adopted.

Mr. George Hume (Vice-Chairman of the Association) said that this matter might properly be placed before the forthcoming meeting of representatives of the Association, the Institution of Gas Engineers, and the gas meter manufacturers.

Mr. Watson's resolution was seconded by Mr. Langlands, and carried.

Finance.

Mr. F. L. Barry (Hon. Treasurer) made a brief statement as to the accounts, and said that there was a balance of £34 7s. 5d. in hand.

His report was adopted.

Election of Officers.

The following Officers, Hon. Officers, and Members of Council were elected to serve during the ensuing year:

President.—H. N. Barrow, J.P. (Chairman, Manchester Justices' Gas Meter Testing Committee).

Vice-Presidents.—C. Chambers, J.P. (Birmingham), J. W. Willoughby, J.P. (Salford), Alderman Sage (Coventry), Councillor F. T. Baker (Nottingham), Councillor Robinson (Sheffield), Bailie Given (Edinburgh), Bailie Newman (Glasgow).

Hon. Treasurer.—F. L. Barry (London County Council).

Hon. Secretary.—Wm. Templeton.

Council.—Geo. Hume (City of London), W. Gordon (Edinburgh), A. Winterbottom (Manchester), J. E. Sloan (Coventry), F. Coe (Nottingham), E. M. Foster (Exeter), F. Colbourn (Birmingham).

Auditors.—F. A. Rolfe (London County Council), E. Simpson (Salford).

It was agreed to hold the annual meeting, 1932, in Edinburgh.

Legal Intelligence

Smokeless Fuel.

Trade Mark Appeal.

Mr. Justice Maugham, in the Chancery Division, on May 19, allowed an appeal under the Trade Mark Acts against a decision dated November, 1930, of the Assistant Controller of Patents, concerning smokeless fuel.

Appellants, Low-Temperature Carbonisation, Ltd., of London and Barugh, near Barnsley, opposed an application by respondents, Magdalena Securities, Ltd., a Canadian Company with works at Cannock, Staffs., to register the word "Ucolite" in order to describe their smokeless fuel. The Assistant Controller had decided that the registration should proceed.

For some years, appellants said, they had used the registered name "Coalite" for their smokeless fuel, and they contended that the adoption of the name "Ucolite" was likely to confuse the public and injure their business. This was denied.

Mr. Justice Maugham, giving judgment, mentioned that he had had evidence before him which the Assistant Controller had not. The onus was upon the applicant for registration to make out that the mark desired to be registered was a proper one. Respondents had never used the mark "Ucolite," and it had to be considered whether the two names were likely to be confused. They might well be, particularly when persons gave orders over the telephone. The Magdalena Company had not succeeded in making out their case for registration, and there would be judgment accordingly, with costs.

Whessoe Foundry and Engineering Company

The Eleventh Annual General Meeting of the Whessoe Foundry and Engineering Company, Ltd., was held on June 11 at 25, Victoria Street, S.W. 1—Mr. HAROLD G. JUDD, C.B.E. (the Chairman of the Company), presiding.

The SECRETARY (Mr. W. T. Pallin) read the notice convening the meeting, together with the Auditors' certificate.

The CHAIRMAN said: In view of the extremely difficult conditions which have prevailed during last year in almost every branch of industry, I think you will agree that the result is not unsatisfactory, representing, as it does, a drop in profits of about one-third as compared with the previous year. It is largely due to the thorough reconstruction of the works in 1929 that the Company was in a position to make profits in a time of such extreme difficulty as we are experiencing.

BALANCE-SHEET ITEMS.

The balance-sheet is, I think, so clearly set out that I need only make the briefest comment upon it. Adequate depreciation has been written off, and the works and plant stand at little more than they did when the Company was formed eleven years ago, although their value has been greatly increased by the amounts expended from time to time, and, in particular, by the reconstruction of 1929.

The investment in our subsidiary Company is represented by tangible assets of more than the book value, and our outside investments at to-day's market price show a satisfactory appreciation.

The reduction in the figures of work in progress and book debts reflects the decrease in the amount of business, and the liabilities on the other side are correspondingly low.

The general reserve remains at the figure of £40,000; the welfare fund of £1000 set aside last year, has been expended in the provision of bowling greens for the employees. That expenditure and the Company's contribution to the Employees' Provident Funds are in our opinion fully justified and are reflected in the *esprit de corps* and loyalty displayed by our numerous employees.

ARRANGEMENT WITH MESSRS. ARTHUR G. MCKEE & CO.

The year has been marked by some interesting developments which we believe augur well for the future of the Company, and are directed to widening the scope of its activities in relation both to the nature of our products and the expansion of our foreign markets. We entered last November into an arrangement with Messrs. Arthur G. McKee & Co., of Cleveland, U.S.A., a firm of the highest standing, who specialize in the construction of blast furnaces, steel works, oil refineries, and similar plant, under which our Company is entrusted with the manufacture of such work in the United Kingdom as we can undertake. We hope for substantial orders from this connection in the future, and some important inquiries have already been received.

With a view to extending our foreign markets, Mr. Spielman paid a visit to South America last summer, when he was able to establish valuable contacts and appointed a firm of high standing to represent us there.

More recently Mr. Hodgson has made a similar visit to South Africa, and although the market there is not so promising at present we believe that his trip will bear good fruit in the future, and we have appointed representatives there also.

RESEARCH DEPARTMENT INSTITUTED.

Another development has been the institution of a Research Department. This has already produced some interesting suggestions as to new lines of specialities which are under careful consideration at the moment. There are other developments into which I need not go to-day and which I only mention to let you know that we are doing everything possible not only to widen our field but to fill it with as great a variety of products as possible.

I cannot close without referring to the special efforts made during the past year by my colleagues, Mr. Hodgson and Mr. Spielman. Their visits abroad have entailed a great deal of additional work, and it is mainly due to their able and wholehearted management, supported by our Works Manager, Mr. Harrison, and the other members of the staff, that we are able to-day to put before you what I hope you will consider a satisfactory account of our stewardship.

I now conclude by moving the adoption of the report and accounts and the declaration of the dividend of 10 p.ct., less tax.

Mr. RICHARD B. HODGSON, M.I.Mech.E. (Managing Director), seconded the resolution, which was unanimously carried.

The retiring Director (Mr. Harold G. Judd, C.B.E.) was re-elected, and the Auditors (Messrs. Peat, Marwick, Mitchell, & Co., C.A.) having been re-appointed the meeting terminated with a cordial vote of thanks to the Chairman.

Malta and Mediterranean Gas Company, Ltd.

GENERAL MEETING

The Ordinary General Meeting of the shareholders of the Malta and Mediterranean Gas Company, Ltd., was held on Tuesday, June 9, at the Offices of the Company, 59-60, Gracechurch Street, E.C. 3—Mr. A. M. PADDON, M.Inst.C.E., Chairman of Directors, presiding.

The SECRETARY (Mr. C. J. Daun) read the notice convening the meeting and the certificate of the Auditors.

By general consent of those present it was agreed to take the Directors' report and statement of accounts as read.

THE CHAIRMAN'S ADDRESS.

The CHAIRMAN, before dealing with the Directors' report and accounts, referred to the loss the Company had sustained in the death of their esteemed and valued Director, Mr. Strachan Child Clarke, which occurred in October last. During the many years Mr. Clarke had been associated with the Company as a Director, said the Chairman, he had devoted much time and attention to their affairs, and he left behind the memory of a loyal colleague and a lovable personality. His place on the Board had been filled by Brig.-General Goland Vanholt Clarke, C.M.G., D.S.O., who had extensive knowledge of European affairs.

Reviewing the progress of the Company during the past year, the Chairman said that the Directors were gratified in being able to present a statement no less favourable than that considered a year ago. The trading results followed very closely in detail those of twelve months since, and, insofar as there was any divergence at all, it was in favour of the present accounts. The general financial position had been materially strengthened, however, in the interim.

The sales of gas during the year amounted to just over 95 million c.ft., a decrease of 1 p.ct. on the figure of a year ago. The figure of unaccounted-for gas had fallen materially, and now stood at 7·89 p.ct., which was an exceptionally favourable figure, having regard to the nature of the area served—the great lengths of mains and the electricity supply afforded by the Government. They had brought down this unaccounted-for gas figure considerably; the process, for which their Engineer deserved great credit, was still going on, and during the latter part of the period under review this creditable figure had been still further reduced. Thirty years ago the unaccounted-for gas figure stood at 25 p.ct. and was a considerable menace to the conduct of the undertaking, the satisfactory position to-day being wholly due to the efforts of their Engineer, Mr. A. E. Buckley.

GOOD COKE SALES.

For every ton of coal carbonized they had sold over 10 cwt. of coke. Their ordinary consumers used gas to the average extent of 26,000 c.ft. per annum, while slot consumers used just over 14,000 c.ft. These were the figures of consumption upon which their Engineer had to build up good trading returns, and that he had accomplished this would be realized from the accounts before them that day. They had received from the sales of gas some £385 less than the previous year, and from residual products £1100 less. Coal had cost £1339 less, while maintenance, renewals, and improvements were £1504 less; but notwithstanding this the latter figure stood at about £10,000, which would convince shareholders that these matters were not being neglected, and they had the assurance of the Engineer that the works and mains were never in a higher state of efficiency than they were to-day.

The total profit for the year had been increased by some £786, while the balance of profit and loss account was £1203 more than a year ago. From the balance-sheet it would be seen that their investments had increased by over £7000, and their actual market value to-day stood at over £108,000.

These figures would convince them that the difficult times of ten years ago had left them for the time being, and there was nothing in present outlook to warrant other than favourable expectancy.

The Company's activities depended upon the naval and military establishments, and they must always be prepared for disturbances. But they realized that there was a certain change taking place in Malta which was favourable to their business, and this was that Malta was tending to become more of a health resort than heretofore; he had heard people say, in fact, that Malta was very far from a bad place to stay in. The Gas Company, therefore, were responding to the opportunity this change gave to their business, and the stability of the Company would be enlarged by these new developments.

The CHAIRMAN then moved that the report and accounts be adopted.

Mr. A. W. OKE seconded the resolution, and there being no

questions asked by shareholders, it was put to the meeting and carried unanimously.

DIVIDENDS.

The CHAIRMAN next moved:

That a dividend of 5 p.ct. (making, with the interim dividend paid in December last, 10 p.ct. for the year) free of income-tax be declared on the ordinary shares, and dividends of 3½ p.ct. and 3¾ p.ct., less income-tax, be declared on the first and second preference shares respectively.

Mr. F. H. JONES seconded the resolution, which was carried unanimously.

RE-ELECTION OF DIRECTOR AND AUDITORS.

Mr. OKE moved the re-election of Mr. Paddon, who was the Director retiring by rotation. The name of Paddon, he said, was a household word in the Gas Industry, and they much valued his services on account of the unique position he held as Gas Engineer and Barrister and on account of his great experience as Director and Chairman of so many companies. They all valued and appreciated their genial Chairman.

Mr. JONES seconded, and the resolution was carried with acclamation, Mr. PADDON briefly acknowledging.

Mr. F. W. CHURCH then moved the re-election of Mr. William Cash, F.C.A., and Mr. Hyde C. Burton, F.C.A., as Auditors of the Company, which was seconded by Mr. F. R. SMITH, and carried.

VOTES OF THANKS.

The CHAIRMAN, in proposing a vote of thanks to the Officers and staff of the Company, remarked that any company in this country would be gratified to have such working results as they had. A very great demand, he said, had been set upon the Company's representatives in Malta. For many years Mr. Buckley had responded nobly to their requirements and had steered the ship with very great adroitness and skill, while his technical ability compared with any in this country. His Assistant, Mr. Wilson, was also a man of great ability and experience, while Mr. Wright was their accountant in Malta, and he sometimes had to be "locum tenens" and was a valuable officer. In London they had in Mr. Daun the most loyal of secretaries; and so he thought the shareholders might very appropriately pass them a hearty vote of thanks for what they had done.

Mr. JONES seconded, and Mr. A. D. DODGSON supported the vote on behalf of the shareholders.

Mr. BUCKLEY, in reply, said that it gave him the greatest possible pleasure to respond to the vote of thanks on behalf of the employees in Malta particularly. He assured them that appreciation of this kind was always very welcome and was a great source of encouragement. "I must say," continued Mr. Buckley, "that the very sound position of this Company is undoubtedly due to the highly skilled and technical advice I receive from this Board of Directors; and I can assure you that the business of this Company, notwithstanding the ups and downs of naval, military, and air force stations, is very well stabilized indeed."

Mr. DAUN also acknowledged the vote of thanks on behalf of the London staff.

Mr. F. W. CHURCH proposed a very hearty vote of thanks to the Chairman and Directors, remarking that it was wonderful for a company to pay a dividend of 10 p.ct. in these days.

Mr. SMITH seconded the vote, which was carried unanimously, and the CHAIRMAN briefly responded, this terminating the business of the meeting.

Cannock, Brownhills, and District Gas Order

On Monday and Tuesday, June 1 and 2, Mr. J. F. RONCA (Director of Gas Administration) held an inquiry, at the Board of Trade Offices, Great George Street, Westminster, into the proposals of the Special Order, promoted under the Gas Undertakings Acts of 1920 and 1929, by the Cannock, Hednesford, and District Gas Company, Ltd., the chief purpose of which is to enable that Company to acquire by agreement the undertaking of the Ogley Hay and Brownhills Gas Company, Ltd., which is supplying gas in an adjoining district. It is also sought to extend the area of supply of the proposed amalgamated undertaking, to include certain adjoining parishes.

The Cannock Company was represented by Mr. Jacques Abady (instructed by Messrs. McDonnell, Jackson, & Co., Parliamentary Agents). Its technical adviser was Mr. George Evetts (Consulting Engineer), and Sir John Ferguson Bell (who is one of the Directors of the Brownhills Company) was also present.

There were objections by the Cannock Urban District Council (represented by Mr. H. Gibbon Pritchard, of Messrs. Sharpe, Pritchard, & Co., Parliamentary Agents) to proposals inserted in the Draft Order providing for the repeal of provisions in previous Orders relating to purchase of the Cannock Undertaking by the Urban District Council. The Brownhills Urban District Council also opposed, and asked that the Draft Order should not be approved by the Board, or that its operation should be suspended for a period, to enable them to obtain Parliamentary power to acquire the Brownhills Company's Undertaking. They were represented by Mr. Maurice Fitzgerald (instructed by Messrs. Lees & Co., Parliamentary Agents), and were advised on the technical side by Mr. Arthur Valon (of Messrs. W. A. Valon & Son, Consulting Engineers). A third opposition was by the Lichfield Gas Company, which entered into agreements with the Brownhills Company in the past concerning the supply of gas in some of the parishes which it is now sought to include within the limits of the amalgamated Company, or have already been included in the limits of the Brownhills Company. The Lichfield Company objected that the proposed scrapping of those agreements by this Draft Order would prejudice its future. It was represented by Mr. Cope Morgan (instructed by Messrs. R. W. Cooper & Co., Parliamentary Agents).

Mr. ABADY, in his opening remarks, said that the Draft Order proposed, in addition to the amalgamation of the two Companies and the extension of the area of supply, to authorize additional capital and to modify, by repeal or revision, provisions in existing Orders. Several objections had been lodged originally, but all had been withdrawn, with the exception of those of the Cannock and Brownhills Urban District Councils and the Lichfield Gas Company. The only opposition to the proposed extension of the area was that of the Lichfield Gas Company, relating to a small part of the area proposed to be added.

It was suggested by the Cannock and Brownhills Urban District Councils that they should have rights of purchase of the undertakings over the areas of the Cannock and Brownhills Companies respectively. The area of supply of the Cannock Company, however, was not co-extensive with the area of the Cannock Urban District; it extended, though only to a small extent, into the Brownhills Urban District, to include part of a parish there; it also included some townships in the Cannock Rural District.

Mr. H. GIBBON PRITCHARD (for the Cannock U.D.C.) said that the existing provisions relating to purchase by the Cannock Urban District Council related to the whole of the Cannock Undertaking as it exists.

Mr. ABADY added that the Brownhills Company's area also was not co-extensive with the Brownhills Urban District, because part of the Urban District was supplied by the Cannock Company and part, he believed, by the Walsall Corporation. So that, if the Brownhills Urban District Council purchased the Brownhills Company's undertaking, it would be purchasing an undertaking supplying only part of its area.

The works of the Cannock and Brownhills Companies were situated about 5½ miles part; there was very little "dead" country in a direct line between them, and there was practically continuity of interest there.

The area of supply of the Cannock Company comprised 31½ sq. miles, and that of the Brownhills Company 7½ sq. miles, and the two areas were contiguous for a distance of 3½ miles. The respective makes were approximately 140 million and 22 million c.ft. per annum. The maximum daily output of the Brownhills Company had been 90,000 c.ft. The works were comparatively small and relatively inefficient, but the storage capacity was 210,000 c.ft. If the amalgamation were approved, the proposal was that the Brownhills Works would be shut down so far as gas manufacture was concerned, but advantage would be taken of the ample storage accommodation which existed there. The concentration of manufacture and management at the Cannock Works would ensure almost the immediate, and certainly the ultimate, benefit of the consumers in both areas. If ever there were a case in which amalgamation was advantageous, this was it.

The proposed terms of the amalgamation were comparatively simple. The issued capital of the Cannock Company amounted to £64,477, including premiums; the standard dividend was 7 p.ct., and it was subject to the sliding-scale. The borrowing powers of the Cannock Company amounted to £37,500, but they had not been exercised. The issued ordinary capital of the Brownhills Company was £9000 of maximum dividend stock. Some of it was distinguished in the balance-sheet as 10 p.ct. stock and some at 7 p.ct., but he dealt with it in the assumption that it was all 7 p.ct. maximum dividend stock. There was also issued £5745 of 5 p.ct. preference stock, and £1150 of 4½ p.ct. debenture stock. The total capital issued by the Brownhills Company, therefore, was £15,895. The capital expenditure, however, at Dec. 31, 1930, was £20,251, so that the Company (as also the Cannock Company) had overspent on capital account.

For the last four years the Cannock Company had paid 8 p.ct. on its ordinary capital. In 1927, 1928, and 1929 the Brownhills Company had paid 6 p.ct., and for the nine months ended December, 1930, it had paid 5 p.ct. Sufficient had been earned to enable the Company to pay 6 p.ct., without drawing on the carry-forward, in respect of that nine months, but an agreement had been made earlier between the two Companies, and, subject to the amalgamation being authorized by the Board of Trade, prohibiting the Brownhills Company from distributing more than 5 p.ct.

The proposals were that the holders of the £9000 of Ordinary Share Capital in the Brownhills Company were to exchange their shares for ordinary sliding-scale stock in the Cannock Company, in the ratio of 8 p.ct. to 6 p.ct.—*i.e.*, for every £5 of Brownhills stock entitled to a maximum dividend of 7 p.ct. they would receive £3 15s. of stock entitled to a standard dividend of 7 p.ct. Preference stock in the Brownhills Company would be exchanged for an equal amount of preference stock in the Cannock Company at 5 p.ct., and the debenture holders would be satisfied by the issue of 4½ p.ct. debenture stock in the Cannock Company. Mr. Abady expressed the view that there could not be a more satisfactory method.

With regard to the price of gas, the Cannock Company had a standard price of 14·8d. per therm. The selling price was 11·4d. for cooking and 12·6d. for lighting. The dividend was based on the higher price, and, in view of the difference between that 12·6d. and the standard price of 14·8d., the authorized dividend was £8 18s. 6d. p.ct., but for the last four years the dividend paid was 8 p.ct.

The maximum price for the Brownhills Company was 16·4d. per therm; the selling price was 13d. for both cooking and lighting purposes.

It was proposed, by the Draft Order, to authorize a maximum differential of 1·6d. per therm for cooking and lighting in the Brownhills area above the price charged for cooking in the Cannock area (now 11·4d. per therm); and in the new areas to be added, a maximum of 2d. per therm above the charge for cooking in Cannock. Thus, if the amalgamated Company exercised its powers to the full, the price for cooking and lighting in Brownhills would be 13d. per therm, as it was to-day.

The Cannock Urban District Council asked the Board of Trade to ensure that the Company should charge a proper differential as between Cannock and Brownhills. The Brownhills Urban District Council, on the other hand, claimed that the proposed differential was too great. He pointed out that under the proposed scheme the two districts would be subject to the sliding-scale, the supply would be in the hands of a well-managed Company, and there was the certainty that as the price was reduced in the Cannock area it would be reduced also in the Brownhills area. It was not intended to deprive either of the local authorities of their right to ask the Board of Trade for a downward revision of the standard price under the provisions of the Gas Undertakings Acts of 1920 and 1929. It had been contended that the existing standard price of 14·8d. per therm was higher than was justifiable on the basis of to-day's costs. He proposed the insertion of a clause in the Order, therefore, providing for a standard price of 13·6d. per therm, being 1·2d. per therm less than the existing standard price in Cannock, without depriving the local authorities of the right to apply for revision.

Mr. PRITCHARD said he had been instructed by the Cannock Urban District Council not to press the criticisms they had made of the financial clauses of the Order.

Mr. ABADY, dealing with the provisions concerning purchase, said it was proposed to repeal a section of the Cannock Company's Order of 1898. This section provided merely that, if the Cannock Council were authorized to purchase the Cannock Undertaking, the Company should sell. Thus, the section in itself did not give the Council power to purchase. Another provision it was proposed to repeal was a section of the Cannock Company's Order of 1911, giving the Cannock Council the power to purchase the undertaking within a specified period. That power had not been exercised within the specified time, however, because the ratepayers had refused to sanction it. There was nothing in the present Draft Order to deprive either the Cannock or the Brownhills Councils of their right to apply to Parliament or the Board of Trade to obtain powers to purchase the undertakings. Referring further to the section of the 1898 Order which it was proposed to repeal, he said that the existing undertaking was not the undertaking referred to therein, because it was enlarged in 1911. He urged that it was not in the public interest that small local authorities should be given the right to purchase small undertakings; in the interests of the consumers it was better to amalgamate small undertakings and so render them as powerful and rationalized as possible.

The Brownhills Council also asked for power to purchase the Brownhills Undertaking. In view of the size of that undertaking and of the Council, the suggestion that the Council should stand in the way of the public interest and deprive the public of the services of a decent sized Gas Company, working efficiently, was grotesque. The Brownhills Council might like to have a small gas-works to play with, or manage, but he suggested that it was not in the public interest that either Council should have the right to purchase. The Brownhills Council, in its objections, had stated that it had been dissatisfied with the supply of gas by the Brownhills Company, and that, as the Brownhills Company was disposing of its undertaking, the Council should be authorized to purchase it. Mr. Abady pointed out, however, that the Brownhills Company was not desirous of disposing of its undertaking. No doubt the Board of Trade would like to know whether or not the Brownhills Council had taken technical advice as to the desirability of acquiring the undertaking. He challenged the statement that the interests of the district were best served by such acquisition. The Brownhills Company would not sell to the Council unless Parliament compelled it to do so.

Objections had been raised to the proposal that the existing three Directors of the Brownhills Company should become Directors of the amalgamated Company, in addition to the four existing Directors of the Cannock Company. Mr. Abady pointed out that under this proposal there would be no compensation payments to Directors of the Brownhills Company.

In a reference to capital powers, Counsel said that the share capital would be increased by only about £12,000 by the proposals of the Order.

Mr. *George Evetts* gave evidence in support of the proposals. He said he was satisfied that amalgamation on the terms proposed would be advantageous to both undertakings. He emphasized that the Cannock Company, being six or seven times as large as the Brownhills Company, had better resources for propaganda and service, while it had up-to-date works, with vertical retorts, producing technical results of a very high order for a works of that size. The Brownhills Works, however, were relatively inefficient, though not obsolete. The storage facilities at Brownhills represented a great asset to the amalgamated Company.

He was asked if he considered that the proposed 1·6d. differential as between the price for cooking in Cannock and the price for cooking and lighting in Brownhills was economically sound and would not prejudice the interests of the consumers in Cannock. His reply was that it should be more, though not substantially more; the Cannock Company had made a surplus, whereas the Brownhills Company had just paid its way, and, therefore, the greater benefit should go to Cannock.

In cross-examination, Mr. Fitzgerald complained that no notice of the negotiations between the two Companies had been given to the Brownhills Urban District Council; and when Mr. Evetts replied that he would have been surprised if it had, Counsel urged that a local authority should reasonably be expected to have an interest and should have power to purchase the undertaking supplying gas in its district. Mr. Evetts replied that if it considered that it could supply better than the Company, it had every right to make that claim in the proper quarter,

It was suggested by Counsel that, bearing in mind the cost of the trunk main from Cannock to Brownhills and the amortization of the Brownhills Works, the cost of supplying gas during the next ten years would be higher than at present. Mr. Evetts pointed out that the cost, per unit of gas sold, would decrease as sales increased.

Another point urged by Counsel was that if the Brownhills Undertaking remained separate it could secure a bulk supply from Cannock or elsewhere, so that economies could be effected without amalgamation. Mr. Evetts, in his reply, emphasized that an amalgamated Company had better facilities than small separate Companies for carrying out propaganda and service.

Asked if it were suggested that the Brownhills Company had been more apathetic than the Cannock Company, he said he did not know whether the results were due to apathy or lack of resources.

In reply to further questions, he said that a local authority might be anti-gas, and in that event it would not be a good thing that it should have control of gas supply. He understood that the Brownhills Company had asked permission to install gas into certain Council houses, but permission was refused.

Mr. FITZGERALD said that the Council had had to wait three years for the Gas Company to lay mains a few hundred yards in order to give a supply to certain houses.

Mr. *Evetts* said he was told that that was not the case.

Mr. FITZGERALD, dealing with the proposals with regard to Directors, said that the three Directors of the Brownhills Company had been receiving £50 per annum each, while the four Directors of the Cannock Company had received over £200 per annum each.

Mr. ABADY pointed out that the fees of Directors were fixed by the shareholders.

Mr. *Evetts* said he understood that the idea was to transfer the Brownhills Directors to the Cannock Company to avoid paying compensation for loss of office, and that as existing Directors dropped out they would not be replaced until the number was reduced to a certain figure.

Asked if he considered that the total cost of Directors' fees would be increased, he said that possibly it would be increased for the time being as the result of the amalgamation. He did not regard it as a certainty.

Discussing further the advantages which he urged would accrue to the Brownhills Company shareholders as the result of the amalgamation, Counsel said that, whereas they had received 6 p.ct. in only two years since the war, they would receive 6 p.ct. at once as the result of the amalgamation, and probably increases due to the economies effected. Mr. Evetts pointed out, however, that the effect of the proposed reduction of standard price would reduce the dividend of the Cannock shareholders to £7 17s. 6d. instead of 8 p.ct., and the return on the money of the Brownhills shareholders, bearing in mind the reduced nominal value of their shares, would be less than 6 p.ct.

A point upon which Mr. Fitzgerald laid emphasis was that the dividend would be based upon the charge for lighting in Cannock, which was higher than the charge for cooking; therefore, there was no incentive to reduce the price for cooking in Cannock until the price of gas for lighting was reduced to the same level, and, inasmuch as the differential charge in Brownhills was based on the cooking price in Cannock, Brownhills was not likely to secure a reduction of price. Mr. Evetts pointed out, in reply, that there was always an incentive to reduce the price for cooking in Cannock, because the district was a mining district, and cheap coal was available to the inhabitants.

He was asked by Mr. Ronca whether it would be necessary to expend more capital on the Brownhills Works if that undertaking remained separate. He replied that he did not think the expenditure would amount to many hundreds of pounds.

[An account of the second day's proceedings will be published next week.]

The Sheffield Gas Bill

South Yorkshire Coke-Oven Gas Grid Scheme

House of Commons Committee.

(*Before Sir* WILLIAM JENKINS (*Chairman*), *Mr.* GREENE, *Mr.* HANBURY, *and Mr.* ROWSON.)

Wednesday, June 3.

The Committee commenced its examination of this Bill on Wednesday, June 3. Its main purposes are to enlarge and alter the powers and obligations of the Sheffield Gas Company with respect to the purchase and supply of coke oven gas, to extend the Company's ordinary limits of supply, and to increase its borrowing powers. (See "JOURNAL" for Jan. 14, p. 105.)

So far as coke oven gas supply is concerned, the Bill seeks to give effect to the recommendations of the Area Gas Committee by extending the area within which the Company may purchase coke oven gas, and to enable it to construct a "grid" of mains whereby it may carry it and provide cheap supplies of gas to industry in South Yorkshire. Another Bill, promoted by the South Yorkshire Gas Grid Company, Ltd., which Company consists of a majority of the coke-oven owners in South Yorkshire, was promoted this session with similar objects, but the Companies discussed the matter and agreement was reached, and the Grid Company withdrew its Bill, leaving the Sheffield Gas Company a clear field. The South Yorkshire Grid Company remains as the organization through which the Sheffield Gas Company is to purchase the coke oven gas.

The Sheffield Gas Company was represented by Sir Lynden Macassey, K.C., Mr. F. G. Wrottesley, K.C., and Mr. Jacques Abady. There was opposition by the West Riding County Council, represented by Mr. Craig Henderson, K.C., and Mr. Thorpe; the Rotherham Corporation, represented by Mr. W. E. Tyldesley Jones, K.C., and Mr. S. G. Turner, K.C., the Swinton and Mexborough Gas Board, the Wath, Bolton, and Thurnscoe Gas Board, and the Rawmarsh, Wombwell, and Stockbridge Urban District Council, all represented by Mr. Thorpe; and the South Yorkshire and Derbyshire Gas Company and the Royston (Yorks) and District Gas Company, Ltd.

Sir LYNDEN MACASSEY, K.C., who said that manifestly the Bill was in the public interest, because it would enable the Company to afford a cheap and comprehensive supply of gas in the area, added that it would benefit the coal and coke industry, by enabling owners of coke ovens to obtain a market for their gas, much of which had had to be wasted for lack of a market. It would also help the steel industry and other industries in the area. This Bill was the first presented to Parliament to enable a gas undertaking to construct a coke oven gas network or grid. In 1917, the Gas Company had been given Parliamentary powers to obtain coke oven gas outside its ordinary gas supply area, because munition makers in Sheffield had been anxious to obtain supplies. It was now proposed that the coke oven gas limits of the Company should be still further extended, for industry would benefit considerably thereby.

Since the Company had first obtained powers to purchase coke oven gas, said Counsel, there had been a complete change in the operation of the Company's system. In 1930 it had bought something like 90 p.ct. of the gas it supplied, and had made only about 10 p.ct. In 1930 it had bought 4755 million c.ft. of coke oven gas. In 1930 it was estimated that there would be a surplus of coke oven gas in South Yorkshire of 8712 million c.ft., and that there would be available a total of 16,000 millions. The general scope of the agreement between the Sheffield Gas Company and the South Yorkshire Grid Company was to give the Sheffield Gas Company the right to purchase coke oven gas from the South Yorkshire Grid Company, which latter represented the owners of coke ovens in the area, at a price of 5½d. per 1000 c.ft., there being a sliding scale to vary the price of the gas in accordance with variations in the price of coal. The calorific value of the unpurified coke oven gas was to be 515 B.Th.U. per c.ft., such purification as was necessary being undertaken by the Sheffield Gas Company. The coke oven owners did not desire to expend the capital involved in providing purification plant at the various coke oven works scattered around the district, and the Gas Company could concentrate purification in one or two places. Further, it was essential that the purification should be undertaken by the Company responsible for supplying the purified gas. The Sheffield Gas Company undertook to develop as far as it could the sale of coke oven gas for industrial purposes in the area to which its powers related.

Under the powers in the Bill, the Sheffield Gas Company would have power, within the extended coke oven gas limits, to buy coke oven gas from 19 coke oven plants referred to in the report of the Area Gas Committee, and would have power to lay mains from the coke ovens and for the purpose of supplying in the area. The Company would have the right to supply coke oven gas in bulk to gas undertakers any part of whose limits of supply was within the Sheffield Company's coke oven gas limits, and the gas could be used in any part of the areas of those gas undertakers, whether within or without the coke oven gas limits of the Sheffield Company. It could also supply any authority, company, body, or person (other than inside gas undertakers) within the coke oven gas limits; but if the users were within the areas of supply of any inside gas undertakers, the permission of those inside gas undertakers must be obtained. Thus, they had an absolute veto on any supply of coke oven gas to consumers in their areas.

There was also a provision by which any gas undertakers through whose area the Sheffield Company's coke oven gas mains passed would have the right to demand a supply of coke oven gas from the Sheffield Company, if they were unable to obtain a supply on reasonable terms from coke oven owners within their own areas of supply. Any dispute as to whether the terms offered were or were not reasonable could be referred to arbitration. There would be an obligation on the Sheffield Gas Company to supply gas to inside gas undertakers up to the full amount of the coke oven gas which the Sheffield Gas Company was entitled to be supplied with by the coke ovens inside the areas of supply of the demanding gas undertakers. Any dispute as to price and conditions of supply was to be referred to arbitration.

The Bill, said Counsel, was the subject of a report from the Board of Trade. The Board supported it, being satisfied that only by a comprehensive scheme of this character, as distinct from isolated purchase of coke oven gas, could the bulk of gas be dealt with at prices sufficiently low to attract the consumer, and in a manner which would give real assistance to the coke oven industry.

Most of the petitions against the Bill were on behalf of gas undertakers whose areas of supply were within the proposed coke oven gas limits of the Sheffield Company, and who feared that the development of their undertakings would be hampered by the operations of the Sheffield Gas Company. The Rawmarsh Urban District Council had a gas undertaking which did not manufacture gas, but bought gas from a coke oven plant a quarter of a mile distant from the works, and distributed it to consumers. It was urged that the price at which the Sheffield Gas Company should give a supply of coke oven gas to the Council, if the latter required it, should be limited to a figure not exceeding by more than 10 p.ct. the average price for the time being payable by the Company for coke oven gas delivered into the network, *plus* a proper proportion of the standing charges applicable to the part of the main utilized for the supply to the Council. Sir Lynden commented that, if effect were given to this, it would destroy the whole principle of the Bill, for it was suggested that the cost of the main should be met, not by charging the inside gas undertakers with their share of the general expenses of laying the main, but by charging each one a special price, which would vary in each case according to the particular circumstances. In any case where there was disagreement as to price, the matter would be referred to an arbitrator; and it was important that he should have his hands free to make allowance for special circumstances.

Mr. THORPE (for the Council) urged that the circumstances in this case were peculiar, and that the Council should have special treatment.

Sir LYNDEN MACASSEY replied that that remark added force to what he had said already—that the arbitrator should be free to examine the whole of the circumstances. Parliament should not give a decision at the present stage, based on one particular case, which decision would no doubt be used as a precedent in subsequent cases.

Coming to the petition of the Wombwell Urban District Council, he said it was stated that the Council had applied to the Board of Trade for a Special Order, in which it sought, among other things, power to make contracts and agreements with producers of coke oven gas within its area, to obtain supplies, and to supply it to consumers for any purpose, subject to certain conditions. Sir Lynden said that the Council asked for some measure of control over the operations of the Sheffield Gas Company in its proposed coke oven gas limits. Surely, however, there could be only one body administering the affairs of the coke oven network. He emphasized also that the Council could obtain from the Company any quantity of coke oven gas up to the amount obtained by the Company from coke ovens within the Council's gas area. The Council wished to secure that the Company should not compete in the purchase of coke oven gas from coke ovens within the Council's gas area. That meant, he said, that coke oven owners in the Council's gas area were to be precluded from selling their coke oven gas to the Gas Company if the Council stated that there was a prospect or probability that at some time in the future it would want to purchase the gas; or else it meant that, if the coke oven owners had entered into a contract to supply the Gas Company, and the Council wanted more gas, then the contract with the Gas Company must be terminated.

A point raised by the Swinton and Mexborough Gas Board was that there were a number of industrial undertakings within its area, with some of whom negotiations for a supply of crude coke oven gas were in an advanced stage, and a successful outcome was expected. The Board expressed the belief that, if the present Bill became law, it would experience great difficulty in obtaining adequate supplies at a price which would permit re-sale. Counsel's comment on this was that there was no immediate probability of a shortage of coke oven gas in the

district. The Board asked for power to renew and extend existing contracts and to enter into new contracts for supplies in priority to the Gas Company for so much of the coke oven gas produced within the Board's coke oven gas limits as it might require.

Thursday, June 4.

Similar points were raised, continued Counsel, in several of the other petitions. The Rotherham Corporation, however, had suggested that the powers sought in the Bill would give the Sheffield Gas Company a virtual monopoly in the coke oven gas available in the Rotherham area, but he denied that this was so. Both the Sheffield Gas Company and the Rotherham Corporation had obtained powers, in 1917 and 1918, to obtain coke oven gas from plants within areas extending beyond their ordinary gas supply limits, and the coke oven gas limits of the two undertakings had overlapped, the area in which they had overlapped being known as the common area. The two undertakings, however, had entered into an agreement whereby the Sheffield Company was entitled to take up to two-thirds of the quantity of coke oven gas produced in that area, and the Rotherham Corporation was entitled to take the remaining one-third, unless both sides consented to either taking a greater proportion than that stated. There was a provision in the present Bill, said Sir Lynden, which maintained the principle of that 1918 agreement. The Rotherham Corporation was buying coke oven gas, within its ordinary limits of supply, from the Yorkshire Chemical Works, Ltd., and from Messrs. John Brown & Co., but, in addition to the amount bought by the Rotherham Corporation, there was still another 6 million c.ft. available from those two works. So that there was ample coke oven gas available to the Corporation inside its existing limits.

Mr. S. G. TURNER, K.C. (for the Rotherham Corporation), disagreed as to the total amount available from the works in question.

The final petition dealt with was that of the West Riding County Council, which claimed that the grid scheme should be permitted only if there were restrictions imposed for the protection of the public, and restrictions as to the use of the roads, for the protection of the local authorities responsible for the roads. The Council also asked for some regulation of prices.

Mr. *Ralph Halkett* (General Manager and Secretary of the Sheffield Gas Company), giving evidence on behalf of the Bill, said he had been responsible for laying many miles of gas mains from various coke ovens to the works in Sheffield, the diameter of these mains ranging from 12 in. to 16 in., the gas being purified at the works. The amount of gas passing through these trunk mains was between 4000 and 5000 million c.ft. annually. By developing the use of coke oven gas, as contrasted with the gas made at the gas-works, he had been able to reduce the price of gas to industrial consumers. Large contracts were running under which gas was supplied at 1s. per 1000 c.ft. Since the price had been reduced to that figure there had been considerable increases in consumption, although Sheffield was suffering badly from trade depression. Despite the depression, manufacturers were able to substitute this gas for other fuels, such as oil, coal, and producer gas; and they were well prepared to cope with increased trade when the opportunity came. He anticipated a substantial increase in the use of gas in the district in the future. Manufacturers were being converted increasingly to the advantages of gas, and some had shut down their own producer gas plants and were using gas supplied by the Company. It was the desire of the Company to reduce the price of gas still further, and one of the objects of the Bill was to enable it to do so. He added that a great deal of solid fuel was still being used in Sheffield industries, and its use gave rise to a considerable amount of black smoke. If manufacturers could use gas economically in place of a dirty fuel, everybody in the district reaped the advantage.

He had made a special study of long-distance transmission of gas from coking plants, and on two occasions had visited the Ruhr district of Germany. There the coke oven gas had been carried greater distances than anywhere else, and it had been most largely used. In Belgium, which he had also visited, there were ring mains supplying gas undertakings within a radius of 40 or 50 miles. In Germany, in 1928, there were 31 coking plants linked up to a grid; since then the programme had been carried further, and coke oven gas was being carried through a system of mains extending over a distance of 200 miles. He had been given every facility for inspection of the system.

Apart from the gas already obtained from coke ovens in and around Sheffield, the Company had three manufacturing stations—Neepsend, Grimesthorpe, and Effingham Street—the total capacity being 24 million c.ft. of coal gas per day. There was also carburetted water gas plant of a capacity of 4½ million c.ft. per day, and a storage capacity of 51 million c.ft.

Referring to the constitution of the Company, he said that seven of the Directors were elected by the shareholders, and three were members of the Sheffield Corporation, being nominated by the Corporation. The Auditors also were nominated by the Corporation, so that the local authority could keep a very close watch on the Company's activities.

Mr. Halkett submitted to the Committee figures indicating the Company's sales of gas for industrial as compared with other purposes. The figures showed that there had not been a great increase in consumption since 1925, but he pointed out that Sheffield was feeling the industrial depression very seriously. The broad feature brought out by the figures was that nearly half the quantity of gas sold by the Company was used for industrial purposes, which was unusual in gas undertakings; indeed, he believed that, of all the gas undertakings in the country, the Sheffield Gas Company sold the highest proportion for industrial purposes.

Referring to the agreement between the Gas Company and the South Yorkshire Gas Grid Company, Ltd., he said there was nothing in it which prevented the Grid Company from disposing of any surplus gas which the Gas Company was unable to take. It was said by the Area Gas Committee that there was about 16,000 million c.ft. available per annum in the district, equivalent to about 43 million c.ft. per day. The maximum day output of the Sheffield Gas Company was about 21 million c.ft. He agreed that there was a large quantity of gas available, which ought to be put into supply, if anyone would take it, and he was confident that people could be induced to take the gas if the price were attractive.

Mr. W. E. TYLDESLEY JONES, K.C., on behalf of the Rotherham Corporation, cross-examined Mr. Halkett at considerable length. He first made the point that the new mains to be laid under the Bill would be treated differently from the existing mains, and complained that the latter would not be called upon to bear any portion of the cost of the new grid.

Mr. *Halkett* replied that the present network of mains had been built up under conditions differing from those which would apply to the new system, and therefore it was considered right that they should not have to bear any portion of the cost of the new grid. The gas obtained by the Sheffield Company from the new network would be metered into the works, and paid for on the same basis as that of any other consumer.

Mr. TYLDESLEY JONES pointed out that the Rotherham Corporation did not itself manufacture any gas, but depended upon its agreements for coke oven supplies. He contended that if the Bill went through in its present form, it would be possible for the Sheffield Gas Company to compete for the supplies of coke oven gas now obtained by the Rotherham Corporation, and, by offering a higher price for this gas, make the price of gas supplied in Rotherham higher than it was at present.

Mr. *Halkett* said that nothing could be done in this direction until the expiration of the present agreements which the Rotherham Corporation had with the coke oven firms; and there was no guarantee that these firms, apart from the existence of the Sheffield Company, would renew the agreements on the old prices. Moreover, Mr. Halkett pointed out that the Sheffield Gas Company's scheme only applied to any surplus gas that was available, and therefore they would not be able to get gas which Rotherham now took.

Counsel then cross-examined with regard to the price to be charged per 1000 c.ft. for gas under the scheme.

Mr. *Halkett* said that, while the estimate of the total capital cost was £500,000, the cost per 1000 c.ft. was difficult to say. It would be higher in the early stages of the scheme than in the later. He accepted the figure of 7·83d. per 1000 c.ft., estimated in the Area Committee's Report as the price which would have to be paid before the gas was distributed, and presumably something would have to be added for profit. What this latter figure would be he was not able to say at the moment.

Mr. TYLDESLEY JONES pointed out that in all the schemes concerned with the electricity supply grid, the estimated prices which the distributors would have to pay were always given, but in this case a new procedure was being adopted of not giving the price which would have to be paid by consumers coming on to the gas grid.

Mr. *Halkett* replied that the electricity grid dealt with all electricity, whereas this gas grid was dealing only with surplus gas, and therefore the conditions were quite different.

The Committee adjourned.

Tuesday, June 9.

Mr. *Halkett* was cross-examined further by Mr. Tyldesley Jones (representing the Rotherham Corporation) with regard to the prices charged for gas for industrial and domestic purposes in the Rotherham and Sheffield areas respectively. Mr. Halkett said that whereas the average price charged for gas for all purposes in Rotherham during the year ended March, 1930, was 2s. 1·46d. per 1000 c.ft., the average price in Sheffield during the year ended December, 1930, was 2s. 0·89d. Thus the average price in Sheffield was fully a halfpenny per 1000 c.ft. lower than that in Rotherham. Thus the small consumers in Rotherham had to pay for the benefit given to industrial consumers, whereas in Sheffield all consumers benefited.

COUNSEL then criticized Mr. Halkett's statement that the industrial gas sales had remained fairly stationary since 1925, owing to the very severe depression of Sheffield industries, and said that the statistics published by the National Federation of Iron and Steel Manufacturers showed that the post-war output of steel ingots and castings in the Sheffield district was substantially higher than the pre-war output with the exception of the strike year (1926), and that there was no fall in output until 1929 and 1930, the year 1927 being a peak year. Therefore the position with regard to the sales of gas by the Company was not due to industrial depression.

Mr. *Halkett* insisted, however, that it was due entirely to increasing industrial depression. The Company depended not only on the steel industry, but also on the smaller trades such as cutlery, silverware, &c., and those trades had never experienced a greater degree of depression than the present.

Mr. TYLDESLEY JONES then discussed the position of gas undertakers within the proposed coke oven gas limits of the Sheffield Company, pointing out that a clause in the Bill provided that if such a local gas undertaker could not obtain a supply from coke oven owners on reasonable terms, he could demand a supply from the grid, up to the amount received by the grid under the

provisions of the Bill from coke ovens in the area of supply of that undertaker. The Rotherham Corporation, he said, would be entitled to demand a supply from the grid if the Sheffield Company were taking gas from coke ovens within the ordinary limits of supply of the Corporation, but it would not be entitled to demand a supply from the grid if the Company were taking gas only from coke ovens in the coke oven gas limits of the Corporation, and beyond its ordinary limits of supply.

Mr. *Halkett* emphasized that in the Rotherham Corporation's area of supply there was available considerably more gas than was utilized by the Corporation, and the whole purpose of the grid scheme was to enable surplus gas to be used. The whole purpose of the scheme was to assist the coke oven and the coal and steel industries, and he emphasized the point that the Company was carrying out the recommendations of the Area Gas Committee. He said he did not think there was one local gas undertaking in the affected area which had not available within its supply area 150 p.ct. more coke oven gas than it required. If the Rotherham Corporation could utilize the coke oven gas in its area, the Company did not want it.

COUNSEL mentioned that the Sheffield Company would not pay for any of this surplus gas until it wanted it, but that if the local undertakers wanted increased quantities in the future they must agree to take it and pay for it now.

Counsel then discussed with witness the terms of the agreement between the Sheffield Gas Company and the South Yorkshire Gas Grid Company, Ltd., concerning the supply of coke oven gas to the Sheffield Company. He pointed out that the Grid Company was to sell to the Sheffield Gas Company if able and willing to do so, but it might be unwilling, and in that event there was no obligation upon it to sell. Another point raised by Counsel was that the coke ovens from which gas was to be supplied belong to the coke oven owners who were constituent members of the Grid Company. The Grid Company itself, he said, would have no coke ovens of its own, and its ability to grant an option to the Gas Company in respect of any gas made at the coke ovens would depend entirely upon whether or not it could make agreements with the coke oven owner. Counsel further urged that in the Rotherham Corporation's limits of supply, for example, the Sheffield Gas Company would compete with the Corporation for the coke oven gas available, so that the Corporation would have to bid against the Gas Company if it wanted the gas; in that case the Gas Company would not get the gas, but the Corporation would have to pay more for it. Before the grid scheme was proposed, the Rotherham Corporation was getting gas at prices ranging down to 4½d. per 1000 c.ft., and he asked if the advent of the grid scheme would not increase the price.

Mr. *Halkett* said it stood to reason that the price of coke oven gas would go up. Many coke oven owners had been driven to sell gas at low prices, sometimes unremunerative prices. The whole purpose of the scheme was to benefit the coke ovens, collieries, and steel industry. Loads in the heavy trades were increasing with the price of gas at 1s. per 1000 c.ft.

COUNSEL later said that the agreement did not give either the Grid Company or the Gas Company a hold on a single cubic foot of gas.

Mr. *Halkett*, however, replied that if the Gas Company could not get gas from one source it could get it from another. There was a surplus of 40 million c.ft. per day in this area, and he could see no other means of utilizing it than the proposed grid.

The question as to the naphthalene content of the gas was then dealt with. The agreement provides that the naphthalene content of the gas at a temperature of 60° Fahr. must not be more than 40 grains per 100 c.ft., but the Area Gas Committee's Report had recommended that the naphthalene content should not be more than 32·5 grains per 100 c.ft. at that temperature. That represented an increase of 25 p.ct. in the permissible naphthalene content. Again the agreement permitted the gas to be delivered at a temperature as high as 80° Fahr. at the point of supply to the grid, which was 5° higher than was recommended by the Area Gas Committee. At higher temperatures, however, the difficulties created by naphthalene were increased, and as the gas cooled, it deposited the naphthalene.

Mr. *Halkett* said steps would be taken to ensure that there was not too great a deposit. The figure of 40 grains of naphthalene per 100 c.ft. of gas was a maximum, and that, in fact, the gas would not contain that quantity.

Another matter to which Counsel directed attention was that the basic price of 5½d. per 1000 c.ft. at which it was proposed to supply the Sheffield Gas Company with coke oven gas was to vary according to the "weighted average cost of Yorkshire coal." He supposed that that meant the gross cost. The important figure, however, to a gas undertaker, was the net cost of coal—*i.e.*, the cost after making allowance for the revenue received from coke, tar, &c. He pointed out that if the gross cost of coal increased, the Sheffield Gas Company would have to pay more to the coke oven owners for gas; but if the prices of tar and coke rose at the same or a greater rate, the cost of making the gas at the coke ovens might not be increased, but might be reduced, in spite of the increase in the gross price of coal. That, in his view, was unjust.

Mr. *Halkett* replied that the price of gas would follow the price of industrial coal.

COUNSEL next contended that the maximum permissible content of sulphuretted hydrogen in the gas of 1000 grains per 100 c.ft. was excessive and would seriously affect the men working in places where it was burned.

Mr. *Halkett* replied that the content of sulphuretted hydrogen in the gas mentioned was the maximum, and, in practice, the amount would not be anywhere near the maximum. It would be impossible to specify a figure of 450 grains, as suggested by Counsel, because at some collieries the percentage of sulphur in the coal was very high.

Mr. CRAIG HENDERSON, K.C., cross-examined on behalf of the West Riding County Council, which is opposing "in the public interests" and with regard to the laying of mains.

Mr. F. J. WROTTESLEY, K.C. (Counsel for the promoters), pointed out that, if public safety were threatened by the proposals of the Bill surely the Sheffield Gas Company would have opposed. Inasmuch as the Company had not opposed it seemed hardly likely that there would be much menace to the West Riding County.

Mr. HENDERSON replied that Sheffield was not in the area of the County Council, and he raised the possibility of danger due to the area being liable to subsidence through mining operations, leading to fracture of the mains. Counsel also objected to the interference with local amenities which would result from the operation of the scheme.

Mr. THORPE, representing a number of the local gas undertakers within the grid area, urged that the constituent members of the South Yorkshire Grid Company would be more inclined to sell their coke oven gas to the Sheffield Gas Company than to other undertakers, so that these other undertakers would be prejudiced when wishing to make new agreements direct for supplies of coke oven gas.

Mr. *Halkett*, however, said he could not imagine that the coke oven owners would sell gas at 5½d. per 1000 c.ft. to the grid when they could obtain 7d. per 1000 from other undertakers.

Wednesday, June 10.

On Wednesday, June 10, Mr. Halkett's evidence was concluded. Re-examined by Mr. F. G. Wrottesley, K.C., for the promoters, he said that the coke oven gas industry was as important as the steel industry. One of its products was metallurgical coke which was used in the production of steel. Mr. Halkett explained that there would be a "grid price" charged for the gas to the industrial consumer, but if an "inside" gas undertaker objected to paying the grid price he could ask an arbitrator to decide what price he should pay. If the "inside" gas undertakers could supply to consumers within their area it was to everyone's advantage that they should do it. The Gas Company had no objection to that whatever.

Sir WILLIAM JENKINS, the Chairman of the Committee, asked what sort of case could be submitted to arbitration.

COUNSEL said he gathered a concession would be made to local authorities such as Rawmarsh, who already had a contract for the supply of the gas if they decided to come on to the grid. It was, however, only to those who were previously taking the gas that this would apply and not to new consumers.

Mr. WROTTESLEY: I hope the Company will fight very hard for the grid price. It is the proper way to make this scheme pay.

COUNSEL added that every time a concession was made to an "inside" undertaker it would put up the price to the industrial consumer whom the Bill was intended to help.

Witness pointed out that the present prices were fixed when there was no demand for the gas.

COUNSEL: In the past this has been a waste product that was unsaleable?

Witness: Yes; in the future it is not going to be unsaleable. Witness, continuing, said that if the Company built the grid they would make the gas a marketable product. They had come to an agreement with the coke oven owners and agreed to buy the gas from them at 5½d. per 1000 c.ft., and the Company considered this a fair bargain in the interests of the industrial consumers who were going to use it.

COUNSEL next referred to the opposition of the Bill from Rotherham Corporation.

Witness agreed that it would suit Rotherham if the gas was allowed to go to waste, and there was no one to buy it but themselves. There was, said Mr. Halkett, no opposition to the Bill from the coke oven owners in the area, nor was there any opposition from the ordinary industrial consumer. The Sheffield Corporation had withdrawn their petition. They were satisfied it would be beneficial to the City and the surrounding area. Nor was there any objections from those who were going to use the gas.

COUNSEL: The only complaints come from people who are not going to use the gas, at least for some years.

Witness: That is so.

Mr. GREENE, M.P. (a member of the Committee), said there were many petitions against the Bill, but the question was, Were the present consumers certain they would get their supply in future, and, furthermore, taking the average, would they get the supply at the same price as before?

Witness replied there was nothing in the Bill to prevent their renewing their contracts with the coke oven owners. The Company were also under an obligation providing they took gas from the coke oven owners' area of supply to give them a supply from the Company's mains.

Mr. ROWSON, M.P. (a member of the Committee), asked if Mr. Halkett was of opinion that greater economy in production and distribution of power would be gained if the surplus gas was joined up with the electric grid scheme and used for making electricity. "Your idea," he said, "of a coke oven gas grid is possible, but it seems expensive. Would it not be cheaper to produce electricity with that surplus gas in your area and distribute it above ground?"

Witness replied that it would be far more expensive. The gas would have to be put under boilers to make electricity. It could be used to far greater advantage by the steel industry as coke. There was one coke oven owner selling his surplus gas for elec-

tricity, but he was getting only 2d. per 1000 c.ft. for it. It would not be an economic proposition. By using it as coke oven gas it benefited the coke oven industry and the steel industry.

Lt.-Col. *Stephenson* (Chairman of the Sheffield Gas Company) was the next witness. Replying to Sir Lynden Macassey, K.C., for the promoters, witness said the policy of the Sheffield Gas Company had been to develop the sale of gas on the cheapest possible basis, and in more recent years particularly for industrial users. Col. Stephenson said the Company were taking a considerable financial risk in promoting the scheme.

COUNSEL: This is a pioneer venture in the Gas Industry?

Witness: Yes; it is rather a speculation. It is one that has fallen to us to carry out on the lines of the Area Committee's Report, and I believe that no organization would be able to do it so well having regard to our experience.

COUNSEL: Would you, as an authority which has assumed the responsibility of carrying out this scheme, regard it as a matter of very great desirability that no unreasonable terms and conditions should be imposed on your development of the scheme.

Witness: I understand the authorities are very keen on this scheme being put into operation, and it cannot be operated unless it is done on a commercial basis.

Replying to Mr. Sydney Turner, K.C., for Rotherham Corporation, Col. Stephenson said the Company would not embark on the scheme unless they were sure it would prove an ultimate source of profit.

COUNSEL next asked witness if he would regard a profit of 2d. per 1000 c.ft. on sales as being "out of the way."

Witness: I do not think at the present time that we are in position to say what price we could get for the gas. We may get varying prices.

COUNSEL: Would you be prepared to say whether that is a reasonable profit?

Witness: I would not be prepared to express an opinion on that.

COUNSEL: Your profits will depend on the price you get?

Witness assented.

COUNSEL said he gathered that the grid would not be constructed if the Gas Company were not sure of making a profit. He then asked if the promoters had had any preliminary discussions with those who were to use the gas on the price question.

Witness said there had been informal talks with an Association representing the Rolling Mill Owners. "They told us the price they did not want to pay," he explained.

COUNSEL: That is very interesting. The lowest price at which you are selling the gas at present is 1s. per 1000 c.ft.

Witness: That is so. Asked how the Gas Company proposed to raise the £500,000 to pay for the grid, witness replied that it had not been decided.

COUNSEL: Do you contemplate that you will require Government assistance?

Witness: We shall be quite prepared to accept it.

COUNSEL reminded witness that the Departmental Report recommended that a grant should be made towards the cost of the network.

Sir LYNDEN MACASSEY, K.C.: If we can get Government assistance we shall be very glad of it.

The CHAIRMAN (to witness): Will you apply for some?

Witness: I think so.

COUNSEL: Is the carrying out of this scheme dependent on your getting assistance from the Government?

Witness: Certainly not.

Mr. J. H. THORPE, cross-examining, asked witness if he understood the ground of the grievance of the gas undertakings he represented who were opposing the Bill.

Witness said he understood it to be that they wanted to remain monopolists.

COUNSEL: You are going to break the ring?

Witness: No; we are going in to use the surplus gas they do not take.

COUNSEL: As a competitor for their custom?

Witness: We are coming in to take the gas which is at present running to waste.

COUNSEL: Do you see why a public utility service should be compelled to suffer for the benefit of the coke oven owners and the steel industry?

Witness: The coke oven owners and the steel industry benefit the community. Col. Stephenson said that when it came to the question of price the Company had to consider the grid as a comprehensive whole, and if they were to make concessions to the small undertaking it would ruin the commercial position.

COUNSEL: You are seeking power to widen your area and bring us into it; this is a far-reaching and comprehensive scheme for the general benefit if the steel trade and coke oven owners and the minority must suffer?

Witness: If the local authority has to pay a little more for its gas, the community as a whole will benefit in the general prosperity.

During Sir Lynden Macassey's re-examination, Mr. THORPE said his clients would be prepared to take gas from the grid if it were offered at a price which suited them.

Col. *Stephenson* said he would be glad to enter into negotiation with the opponents to the Bill on the question of price.

Owing to the turn events had taken, Sir Lynden did not pursue his questioning on this point.

Further questioned by Counsel, *Witness* said that Sheffield was a basic Company, and there was an incentive to them to sell gas at as low a price as possible. In reply to Mr. Hanbury, M.P. (member of the Committee), witness said that if the Bill was passed municipal undertakings in and around Sheffield would not be shut out. Answering Mr. Rowson, M.P., witness said fresh industries would not start up when the grid came into operation, but a large number of industries now using solid fuel would use gas, and the health of the community would benefit.

Mr. *Arthur Valon*, Chartered Gas Engineer, of London, who gave evidence on behalf of the promoters, said the Sheffield Gas Company had impressed all technicians whom they had consulted about the scheme that they wanted to be not only fair but rather more than fair to other gas undertakings, and he thought they had succeeded. Replying to Mr. Abady, witness said there would be a great loss of heat in converting coke oven gas into electricity.

The Committee then adjourned until Thursday morning.

Thursday, June 11.

Mr. TYLDESLEY JONES cross-examined Mr. Valon. Dealing with the relative positions of the Sheffield and Rotherham Gas Undertakings, in respect of the industrial load, Counsel put it that, whereas since 1927 the Sheffield industrial load had increased by 1930 by 7 p.ct., the increase in the Rotherham industrial demand in the same period was 600 p.ct.

Mr. *Valon* said the difference in percentage was due to the very small industrial load in Rotherham in 1927.

Mr. Tyldesley Jones' point was that Rotherham is developing at a more rapid rate than Sheffield, and therefore would be prejudiced if difficulties are put in the way of its buying larger quantities of coke oven gas.

In answer to Mr. Thorpe (for a number of local authorities), who suggested that by utilizing the surplus gas, now wasted, the scheme would not benefit the collieries, Mr. Valon said the Sheffield Company would be paying £550,000 per annum for the extra gas it would take; and so far as the coke ovens were associated with the collieries, then the collieries must benefit.

Mr. THORPE then questioned as to the position of the gas authorities which he represents in the event of the Sheffield Company taking the surplus gas from the coke ovens now supplying these authorities. He asked whether the surplus gas, not now required by these local authorities, would be lost to them for ever if the Bill went through.

Witness said it would not be lost, because these authorities could obtain extra supplies from the grid. At the same time, the existing authorities would have the right to demand from the coke ovens in their areas all the gas they required, before any surplus was sold to the Sheffield Company. Therefore, he suggested that the position of the small local authorities represented by Mr. Thorpe would be protected.

COUNSEL then discussed the price to be charged under the grid scheme, and suggested that a fair price which should be charged to bulk customers of the grid should be 10 p.ct. above the price which the Sheffield Company paid to the coke ovens.

Witness disagreed, and said a proper basis would be the cost of the gas to the Sheffield Company *plus* a proportion of the cost of operating the grid.

COUNSEL remarked that the promoters had suggested he should make a proposal on price, and he hoped what he had said would be considered.

Sir LYNDEN MACASSEY, K.C. (for the promoters): It shall be carefully considered.

Mr. *Frank H. Jones* was the next witness for the promoters, and he expressed the opinion that the scheme was the only possible way to make use of the surplus coke oven gas in this area. The Area Gas Committee in its recommendations did not suggest that it should be compulsory on the owners of any grid to give a supply, when called upon, but the Bill included powers by which any other gas authority could demand a supply. Speaking of the suggestions that the gas in the grid will not be pure, and will be deleterious in various ways, Mr. Jones said that the Sheffield Company was now supplying 90 p.ct. of its output in coke oven gas, in a purified form, and the gas going into the grid would have to be treated for the purpose for which it was required. Some people would want the gas in a crude form at a lower price; and they would have to treat it in the best possible way.

Questioned by Mr. Tyldesley Jones, K.C., as to his experience with coke oven gas,

Witness said that ten or twelve years ago the Rotherham Corporation asked him to advise them as to the use of coke oven gas, and he advised them to do what they were doing to-day—viz., use coke oven gas entirely. Also, as a Director of the Amiens and Boulogne Gas Companies, he was now investigating the use of coke oven gas.

Mr. *James Bartholomew*, a Director of the South Yorkshire Grid Company, and the Wombwell Coke and By-Products Company, was then called. He said that the operation of the Bill would give facilities for the further re-construction of plants, and a much larger quantity of gas would be obtained for the carbonization of the same quantity of coal. The total gas made in 1928 by the companies comprising the Grid Company was 85,000 million c.ft., and the amount available for the grid was 2935 millions. In 1930 it was estimated that the quantity of coke oven gas made was 50,000 million c.ft., and the quantity available 8712 million c.ft.; and if the ovens were all re-constructed, the quantity of gas available would be largely increased. Without such a network of mains as that proposed in the Bill there would be no prospect of making use of the surplus gas in this area. Should this Bill not pass, then the South Yorkshire Grid Company would promote a Bill next year on the lines of the Bill which that Company withdrew this Session. Witness added that under Clause 7 of the Bill, the coke oven owners preserved their individual rights to enter into separate contracts for the disposal of their surplus gas, and that had been done deliberately. It was a clause to which the coke oven owners attached considerable importance, because it allowed them to make local contracts or a contract with the

Grid Company. Speaking of purification of the gas, witness said it had been decided that it would be better to supply the gas in the crude state, because that would avoid large capital expenditure on the part of the colliery companies on purification plants, and also because many undertakings preferred to take the crude gas, on account of the lower price.

Mr. TYLDESLEY JONES, K.C., for the Rotherham Corporation, in cross-examination, put the point that the individual coke oven owners were under no obligation to supply under the agreement with the Grid Company, and that the Committee was being asked to sanction a Bill by which the coke oven owners were under no liability.

Witness agreed, but added that a further agreement was being drawn up between the Grid Company and the coke oven owners, although it was not possible to put it forward at the moment.

COUNSEL: Then the Committee is being asked to pass a Bill which really depends on an agreement which you say we shall not see?

Witness: There will be an opportunity to see the agreement when it is completed, but it is not yet completed.

COUNSEL retorted that Parliament was being asked to grant powers for laying mains in public streets in order that two people might put their heads together and compete for the coke oven gas supply.

Mr. ABADY, re-examining witness on behalf of the promoters and dealing with the point concerning the position of the coke oven owners, pointed out that the coke oven owners to-day were perfectly free to supply their gas to whom they pleased, and there was no power for Parliament to compel them to sell to any particular people. That position would be maintained if the Bill was passed.

Mr. HANBURY (a member of the Committee) asked whether it would have been possible to form the Grid Company in a way which did not bring in all the coke oven companies as at present, but make them subject to the control of the Sheffield Gas Company.

Witness expressed the view that the arrangements that have been made are the best possible because of the difficulty of the coke oven companies in finding new capital.

The CHAIRMAN asked if the Grid Company had discussed the desirability of asking for Government assistance in raising capital.

Witness said that stage has not yet been reached.

Mr. *F. T. Rennison,* Industrial Superintendent to the Sheffield Gas Company, spoke of the development in the use of gas for industrial purposes. For instance, the Firth-Derihon Stamping Company had recently given up all their coal-fired furnaces for re-heating blanks for forgings and stampings, and had adopted gas. Another case was Howell & Co., who had within the past three years substituted town gas for all their heating and re-heating processes. A scheme had been placed before that firm for billet re-heating using town gas at the price of the hot producer gas now used, and he fully anticipated that this scheme would be adopted, especially as the Chief Engineer of that Company had visited Germany, and had seen what is being done there. Messrs. Thomas Firth and John Brown, Ltd., the English Steel Corporation, and other firms were mentioned as having transferred from coal or producer gas to town gas for steel making and treating purposes. In the case of Thomas Firth, gas was being used for billet re-heating, the only instance in operation of which he was aware. In other cases, coal fired and producer gas fired furnaces had been replaced by town gas. The capacity of the plant converted to town gas in recent years was capable of using 250 million c.ft. of gas per annum; but owing to the industrial depression the quantity consumed was about half that.

Other firms were mentioned, and witness expressed the opinion that the possibilities for the use of town gas in Sheffield were such as to exceed the supplies of coke oven gas. There was no doubt as to the willingness of industrial firms to use crude coke oven gas, their only fear being that so many restrictions would be put upon them that the price would be increased. There were certain industries, however, where crude coke oven gas could not be used, such as in the case of the manufacturer of open hearth steel, which had a low sulphur content; and in those cases the gas would have to be purified on the steel works. The prejudice, however, that used to exist against the use of gas for industrial purposes had been completely overcome.

Mr. *James Cunningham,* Consulting Engineer in private practice, and formerly associated with Thomas Firth & John Brown, Ltd., said he had investigated the use of coke oven gas in some of the largest steel works in the country. Speaking of the sulphuretted hydrogen content, witness remarked that, although considerable attention had been paid to this, it was desirable that much further investigation should take place before any restrictions of a prohibitory nature were imposed. While it was desirable to keep the sulphur content as low as possible, the fact that the gas contained as much as 1000 grains of sulphuretted hydrogen per 100 c.ft. would not put it out of the market for all industrial purposes. In some cases the gas would have to be purified.

Result of the Proceedings.

In brief, the following is the result of the proceedings to date, which came to hand just as we were going to press.

On Tuesday morning it was announced by Mr. Tyldesley Jones that an agreement had been reached between the Sheffield Gas Company and the Rotherham Corporation. The Rotherham Corporation have a main existing, between their gas-works and the South Yorkshire Chemical Works, Ltd., at Greasborough, and the Canklow Works of Messrs. John Brown & Co., Ltd., and are receiving coke oven gas therefrom. The object of the agreement was to enable them to secure a continued supply after the existing agreements with the two works mentioned have expired, but through the Corporation's existing main. The agreement provides that the Corporation, by giving notice before their existing agreements expire, may require the Sheffield Gas Company to supply them with gas through the existing main up to 4 million c.ft. per day from the Chemical Works and up to 2 million c.ft. per day from Messrs. John Brown & Co., or up to such other quantity as the Sheffield Gas Company obtains from these two works, whichever is the less. If they do not exercise their rights before the existing agreements expire, they may subsequently demand up to 3½ million c.ft. per day or such quantity as the Sheffield Company may obtain from the Chemical Works. The price to be paid by the Corporation to the Sheffield Company for the gas is to be the price at which it is bought by the Sheffield Company, plus ¼d. per thousand c.ft. The Corporation will be entitled also to a further supply of coke oven gas from the Sheffield Company under the terms of the Bill, so far as it is available, at prices to be agreed or determined by arbitration.

An agreement was also reached between the Sheffield Company and the Rawmarsh U.D.C., the Wath, Bolton, and Thurnscoe Gas Board, the Swinton and Mexborough Gas Board, and the Wombwell U.D.C. This laid down that the price at which the Sheffield Company should supply these gas undertakers should be, for industrial use, the price paid by the Sheffield Company to the Grid Company, plus 10 p.ct., and, for domestic use, the price paid by the Sheffield Company plus 1½d. per thousand c.ft.; alternatively, they could pay a price for gas for all purposes, equivalent to the price paid by the Sheffield Company, plus 1d. per thousand c.ft.

The Committee agreed to the principles of these agreements.

The South Yorkshire and Derbyshire Gas Company and the Royston (Yorks) and District Gas Company, who, until this stage, had reserved Counsel, now intervened. Their Counsel was Mr. Cope Morgan, who asked that they should have the right to take gas from the grid on terms not less favourable than those ceded to the Rawmarsh U.D.C. and the other opponents, apart from the Rotherham Corporation.

It was stated that an agreement had been arrived at between the Sheffield Company on the one hand and the Derbyshire and Royston Companies on the other, whereby the price to be paid by these two Companies for gas from the grid should never exceed by more than 2½d. per thousand c.ft. the price at which the Sheffield Company bought the gas. It was also alleged that there had been a misunderstanding on the part of the negotiators. The point of view of the Sheffield Company, however, was that the two Companies concerned, having secured a very favourable agreement, should stand by it and should not now ask for "most favoured nation" treatment, or treatment equal to that ceded to other opponents the circumstances of whose case had been placed before the Committee. The circumstances of these other two Companies were different.

After hearing arguments, the Committee gave no decision, but intimated that they would like the Sheffield Gas Company to consider the matter further.

The proceedings were adjourned until Friday, June 19, when the Committee will consider clauses to embody the agreements arrived at.

Corporation Undertakings' Results for 1930-31.

BRIGHOUSE.

In presenting the accounts of the Brighouse Corporation Gas Department for the past year, Alderman J. F. Bottomley said the policy had been to supply gas as near cost price as possible, but the undertaking had made a profit of, roughly, 1d. per 1000 c.ft., the surplus amounting to £858. Unfortunately, sulphate of ammonia—which in 1914 yielded a profit of £1290 and in 1919 a profit of £1408—had for the time being ceased to be a source of revenue, and last year was sold at a loss of £150.

CHORLEY.

At a meeting of the Chorley Town Council, on May 28, Alderman T. Heald reported a gross profit of £10,072, compared with £9335 last year, on the Gas Undertaking. After paying interest and sinking fund charges there was a net profit of £2651, compared with £2675. Having contributed £1760 to depreciation fund and allowed £891 for other depreciation charges there would be no balance of profit available for rate relief.

DUKINFIELD.

The report on the working of the Dukinfield Gas Department for the year ended March 31 last shows that the sale of gas has amounted to 94¾ million c.ft.—a decrease on the previous year of 4½ millions. The net profit on the Undertaking amounts to £1308.

ST. HELENS.

At a meeting of the Gas and Lighting Committee of the St. Helens Corporation, the Borough Treasurer reported that for the year ended March 31, 1931, the Gas Department had made a net profit of £17,522. The average net price received for gas was 31·94d. per 1000 c.ft.

Parliamentary Intelligence

[From Our Special Correspondents.]

House of Lords.

Private Bills.

The Ministry of Health Provisional Order Bill, dealing with the Stretford and District Gas Board, has been brought from the Commons, read a first time; and referred to the Examiners.

The Royal Assent has been given to the Lowestoft Water and Gas Bill, the Guildford Gas and Cranleigh Electricity Bill, and the Mid-Southern District Utility Bill (originally entitled the Aldershot Gas, Water, and District Lighting Bill).

House of Commons.

Private Bills.

The consideration, on report, of the Gas Light and Coke Company Bill, as amended, has been deferred. Further amendments are to be proposed by the promoters.

The Sheffield Gas Bill is still under consideration by Group "G" Committee.

The Royston and Brodsworth Gas Bill has been read a second time and referred to the Committee on Unopposed Bills.

Special Orders.

Plans have been deposited in connection with the following Special Orders: Gloucester Gas (No. 2); Newquay (Cornwall) Gas.

New Capital Issues.

Haslemere and District Gas Company.—The issue of £7000 6 p.ct. redeemable preference stock, which was offered on behalf of the Directors of this Company, was largely over-subscribed, the tenders ranging from £105 per £100 down to the minimum of par.

Littlehampton Gas Company.—As will be seen from our advertisement columns, Messrs. A. & W. Richards are offering for sale by tender, on behalf of the Directors of the Littlehampton Gas Company, £11,000 new capital, comprising 2200 £5 "B" ordinary shares, at a minimum price of issue of £5 15s. per share, yielding at that price £6 19s. 2d. p.ct. Tenders must be received not later than 11 a.m. on Tuesday, June 23.

Trade Notes.

Gas-Works Equipment.

A booklet issued by the Connelly Iron Sponge and Governor Company, of New York, Elizabeth, and Chicago, deals with various gas-works plant, including governors, high-pressure service regulators, booster settings, direct-reading calorimeters, gas testers, &c.

Coal-Handling Plant for Power Station.

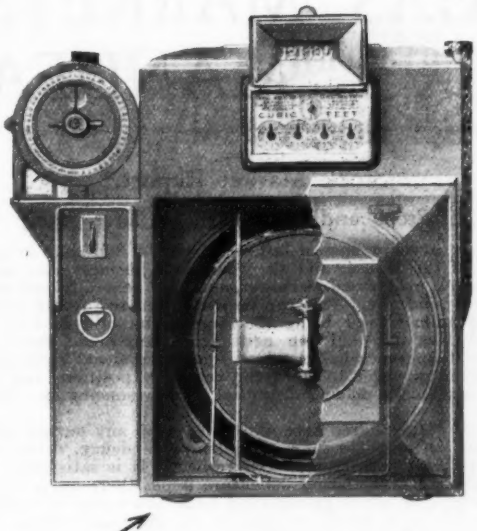
The boiler house coal-handling plant extensions for the County of London Electric Supply Company at their Barking Power Station has been placed with Messrs. Robert Dempster & Sons, Ltd., of Rose Mount Iron Works, Elland, Yorks., and comprises two 125 tons per hour gravity bucket conveyors. This firm also carried out the existing boiler house coal plants, including two 75 tons and two 100 tons per hour gravity bucket conveyors and electric telphers.

British-Made Glassware.

We have received from Messrs. Hailwood & Ackroyd, Ltd., three of their most recent leaflets showing their latest productions. One of these shows a range of architectural lighting fittings, including wall brackets, shades, ceiling fittings, table lamps, candelabra pendant fittings, bowl pendant fittings, &c. The glassware is of carved art and also deep engraved (verre grave) design. Metalwork is finished copper bronze, chromium plated, &c. Another leaflet illustrates carved art panels, deep engraved (verre grave) panels, cylinders, tubes, square boxes, channel sections, angle sections, glass leaves, &c., which can be built up into various kinds of fittings. The third illustrates a few of the firm's advertising globes.

Sand-Blasting and Silicosis.

The increasing adoption of sand-blasting of machine parts and castings to obtain a better finish has without doubt increased the Silicosis risks among workmen. Much consideration has for some time been given by works Managers as to the best methods to adopt to combat the effects of the fine dust which is set up during sand-blasting operations. Efficiency and speed has to be kept in mind; otherwise the blasting becomes an expensive operation. The principal item therefore upon which care of selection has to be exercised is the abrasive; various mediums are in use, but all add very seriously to the dust trouble. A dustless flint grit abrasive has, however, been put on the market by Thos. Vickers, Ltd., of 14, New Street, Birmingham, which is a natural product, and after some very severe tests is found to be most efficient in its operation and practically dustless, owing to its being so hard that it does not break up or splinter. It is anticipated that this new abrasive will fulfil all the conditions of the recent Silicosis Order, and at the same time give engineers a medium which will carry out the most exacting requirements of finish.



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GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

The new Account opened last week with a dull tone in most sections of the House, and the volume of business was small. As the week progressed, however, markets generally exhibited a brighter tendency. This can be attributed to several causes; the chief among these being the large influx of gold into the Bank of England and the news from Australia that the Premiers' Conference had resolved upon a financial reconstruction scheme in order to right the economic position, and this Dominion's stocks made substantial improvements in consequence.

Gas stocks and shares were unperturbed by any outside influences and continued to show a hardening tendency, debentures being especially noticeable in this respect. It is satisfactory to note that among the larger debenture issues there are a few at the present time which give a yield little above that obtainable on some stocks in the front rank of the gilt-edged class. The following is a list showing the yields at the average current prices, and it will be noticed that Commercial 3 p.ct. and Tottenham 4 p.ct. (both *ex* div. last week) are particularly attractive:

—	Interest. P.Ct. per Annum.	Price.	Yield. P.Ct. per Annum.
			£ s. d.
Bristol	4	79	5 1 3
Commercial	3	57½*	5 4 4
Gas Light	3	62½*	4 16 0
Newcastle	5	99	5 1 0
South Metropolitan	3	62½	4 16 0
Do.	5	101½	4 18 6
South Suburban	5	102½	4 17 6
Tottenham	4	76½*	5 4 6
Wandsworth	5	101½	4 18 6

*Ex. div.

A further large amount of business was done in Imperial Continental ordinary stock; the price steadily increasing during the week, and closing 15 points up at 320-340. A well-merited improvement was that of Alliance and Dublin ordinary by 2 points to 102-107, and some further appreciation is justified. The Company has distributed £7 12s. 6d. p.ct. per annum for the past three years, so that the yield on the current price works out at the high rate of nearly £7 6s. p.ct. Another increase was that of Newcastle 4 p.ct. preference, with a gain of 1½ points to 75-77 at the local Exchange. Apart from *ex* div. reductions, the only fall was a fractional drop in Liverpool ordinary (at the Liverpool Exchange) to 100½-101½.

A new issue of interest during the week was that of Primitiva Holdings, Ltd., which has invited its shareholders to subscribe for 250,000 6 p.ct. redeemable cumulative preference shares of £1 each at par. This Company holds 76 p.ct. of the ordinary shares of the Primitiva Gas Company, Ltd., and the prospectus states that the proceeds of the issue will be entirely spent in the purchasing of goods and materials in the United Kingdom to meet the requirements of the Primitiva Gas Company in Buenos Aires. The shares, when issued and fully paid up, will be converted into stock, which will carry a preferential dividend, payable on Jan. 1, 1932, of £2 3s. 4d. p.ct., less income-tax, being 6 p.ct. per annum on calls from their due dates to Dec. 31 next. The stock is to be redeemed at 105 by agreement with any stockholder, or by drawings at 105, but the Company retains the right to redeem at 110 at any time on six months' notice.

Current Sales of Gas Products.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *June* 15.

The values of tar products in the London market remain unchanged, and are as on June 1.

Tar Products in the Provinces.

June 15.

The average prices of gas-works products during the week were: Gas-works tar, 17s. 6d. to 21s. 6d. Pitch—East Coast, 44s. 6d. to 45s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 44s. 6d. to 45s. f.o.b.* Toluole, naked, North, 1s. 7¼d. to 1s. 7¾d. Coal-tar crude naphtha, in bulk, North, 5¾d. to 6¼d. Solvent naphtha, naked, North, 1s. 3d. to 1s. 3½d. Heavy naphtha, North, 11d. to 1s. Creosote, in bulk, North, liquid and salty, 3¼d. to 3½d.; low gravity, 1¼d.; Scotland, 3¼d. to 3½d. Heavy oils, in bulk, North, 5¾d. to 5⅞d. Carbolic acid, 60's, 1s. 1d. to 1s. 2d. Naphthalene, £10 to £12. Salts, £3 to £5, bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port, it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *June* 13.

Interest is reviving in certain items, but, on the whole, conditions continue quiet, with quotations irregular according to the individual position of each distiller.

Pitch.—The export price remains nominal at about 37s. 6d. per ton f.o.b. Glasgow, while home trade is poor at 35s. to 37s. 6d. per ton f.o.r.

Refined tar to Ministry of Transport Specification is again in better call, but value remains easy at 2⅞d. to 2⅝d. per gallon f.o.r. works naked.

Creosote.—Supplies are not plentiful and values are steady. B.E.S.A. Specification is 2¾d. to 3d. per gallon; low gravity, 3⅛d. to 3⅜d. per gallon; and neutral oil, 3¼d. to 3½d. per gallon—all f.o.r. in bulk.

Cresylic.—Market continues dull, but prices are unchanged. Pale, 97/99 p.ct., is 1s. 3d. to 1s. 4d. per gallon; dark, 97/99 p.ct., 1s. 2d. to 1s. 3d. per gallon; and pale, 99/100 p.ct., 1s. 5d. to 1s. 6d. per gallon—all f.o.r.

Crude naphtha is unchanged, with value steady at 4¼d. to 4¾d. per gallon according to quality.

Solvent naphtha.—Inquiries are increasing; 90/160 grade being 1s. 3d. to 1s. 4d. per gallon, and 90/190 grade about 1s. 1d. per gallon.

Motor benzole.—Makers are holding out for 1s. 3d. to 1s. 4d. per gallon *ex* works in bulk.

Pyridines.—90/160 is 3s. to 3s. 3d. per gallon, and 90/140, 3s. 6d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole:

	s.	d.		s.	d.	
Crude benzole	0	6½	to 0	7½	per gallon at works	
Motor "	1	1	" 1	2	"	"
Pure "	1	5	" 1	6	"	"

Contracts Advertised To-Day.

Coal.

The Workington Town Council invite tenders for the supply of gas coal. [Advert. on p. 894.]

The Teignmouth Urban District Council invite tenders for the supply of gas coal. [Advert. on p. 894.]

The Gas Committee of the Clitheroe Corporation invite tenders for the supply of coal. [Advert. on p. 894.]

The Sittingbourne and Milton Urban District Council invite tenders for the supply of gas coal. [Advert. on p. 894.]

The Gas Committee of the Sutton-in-Ashfield Urban District Council invite tenders for the supply of coal. [Advert. on p. 894.]

Condensing Plant.

The County Borough of Wallasey invite tenders for the supply of condensing plant. [Advert. on p. 894.]

Exhausting Plant.

The County Borough of Wallasey invite tenders for the supply of exhausting plant. [Advert. on p. 894.]

Incandescent Mantles.

The Gas Committee of the Sutton-in-Ashfield Urban District Council invite tenders for the supply of incandescent mantles. [Advert. on p. 894.]

Oil, &c.

The Gas Committee of the Sutton-in-Ashfield Urban District Council invite tenders for engine and cylinder oil, and engine waste. [Advert. on p. 894.]

Steam Tubes and Fittings.

The Gas Committee of the Sutton-in-Ashfield Urban District Council invite tenders for the supply of puddled iron steam tubes and fittings. [Advert. on p. 894.]

Washer.

The County Borough of Wallasey invite tenders for the supply of a Livesey washer. [Advert. on p. 894.]

STOCK AND SHARE LIST.

[For Stock Market Report, see earlier pages.]

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr.	Dividends. Last Hf. Yr.	NAME.	Quotations. June 12.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
£			% p.a.	% p.a.				
171,978	Stk.	Feb. 5	5	5	Aldershot 5 p.c. max. C. ...	77—82	...	...
522,992	,,	,,	4	4	Do. 4 p.c. Pref. ...	75—80	...	...
1,551,868	,,	Apl. 9	7⅞	7⅞	Alliance & Dublin Ord. ...	102—107	+2	103½—105⅛
374,000	,,	Jan. 8	4	4	Do. 4 p.c. Deb. ...	72—77	...	75
522,655	,,	Mar. 5	7	7	Barnet Ord. 7 p.c.	124—129	...	126—127½
300,000	1	Apl. 23	1/4⅛	1/9⅜	Bombay, Ltd.	16/6—18/6	...	...
174,500	10	Mar. 5	9	9	Bournemouth 5 p.c. ...	15—16	...	15½—15⅞
500,050	10	,,	7	7	Do. B 7 p.c. ...	12⅝—13½	...	...
439,160	10	,,	6	6	Do. Pref. 6 p.c. ...	11½—11⅝	...	...
50,000	Stk.	Dec. 18	3	3	Do. 3 p.c. Deb. ...	60—63	...	...
162,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	81—84	...	...
357,900	,,	Mar. 19	7½	7½	Brighton & Hove 6 p.c. Con.	112—117	...	115
371,880	,,	,,	6⅜	6⅜	Do. 5 p.c. Con.	104—107	...	...
1,287,500	,,	Feb. 19	5	5	Bristol 5 p.c. max.	95—96[a]	...	...
120,420	,,	Dec. 18	4	4	Do. 1st 4 p.c. Deb. ...	78—80[a]	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	78—80[a]	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	99½—100½[a]	...	...
855,000	,,	Apl. 9	7	8	British Ord.	110—115	...	...
100,000	,,	Dec. 18	7	7	Do. 7 p.c. Pref.	110—115	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	74—77	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	92—97	...	...
160,000	,,	Jan. 8	5	5	Cambridge 5 p.c. Deb. ...	95—98	...	...
100,000	10	May 21	6	8	Cape Town, Ltd.	9—10	...	9⅛
100,000	10	May 7	4½	4½	Do. 4½ p.c. Pref. ...	6½—7½	...	...
150,000	Stk.	Dec. 18	4½	4½	Do. 4½ p.c. Deb. ...	72—77	...	...
626,860	,,	Feb. 19	6	6	Cardiff Con. Ord.	96—99	...	...
237,860	,,	Jan. 8	7½	7½	Do. 7½ p.c. Red. Deb. ...	97—100	...	...
157,150	,,	Feb. 19	5	6⅜	Chester 5 p.c. Ord.	85—90[b]	...	...
98,936	1	May 7	†2/-	†2/-	Colombo, Ltd. Ord.... ...	28/—33/-	...	...
24,500	1	,,	1/4⅛	1/4⅛	Do. 7 p.c. Pref.	17/6—19/6	...	...
609,204	1	Apl. 9	1/4⅛	15·27[d]	Colonial Gas Assn. Ltd. Ord.	16/—18/-	...	...
296,053	1	,,	1/7⅛	17·67[d]	Do. 8 p.c. Pref.	17/6—19/6	...	...
2,073,280	Stk.	Feb. 19	6	6	Commercial Ord.	93—96	...	94½—95½
475,000	,,	June 11	3	3	Do. 3 p.c. Deb. ...	56—59*	—1	...
787,560	,,	Feb. 19	7	7	Croydon sliding scale ...	108—111	...	...
453,100	,,	,,	5	5	Do. max. div.	82—85	...	84
542,270	,,	Mar. 5	7	10	Derby Con.	120—128[c]	...	...
55,000	,,	Dec. 18	4	4	Do. Deb.	65—70[c]	...	...
209,000	,,	Mar. 5	5	5	East Hull Ord. 5 p.c. ...	72—75	...	...
1,002,180	,,	Mar. 19	†4	†6½	European, Ltd.	85—95	...	85—95
18,953,033	,,	Feb. 19	5⅜	5⅜	Gas Light & Coke 4 p.c. Ord.	18/9—19/9[f]	...	19/—19/4½
2,600,000	,,	,,	3⅜	3⅜	Do. 3½ p.c. max.	64—67	...	66—67
4,294,691	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	78—81	...	80½—81
5,694,095	,,	June 11	3	3	Do. 3 p.c. Con. Deb. ...	61—64*	...	62[11]/16—64⅛
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	99—102*	—2	...
2,500,000	,,	,,	—	—	Do. 4½ p.c. Red. Deb. ...	95—98*	—½	95½—97½
161,480	,,	Mar. 5	10	10	Harrogate Cons. 10 p.c. max.	158—163	...	...
82,500	,,	Mar. 19	7	7	Hastings & St. L. 5 p.c. Conv.	98—103	...	...
258,740	,,	,,	5½	5½	Do. 3½ p.c. Conv.	82—85	...	...
70,000	10	Oct. 9	§	10	Hongkong & China, Ltd. ...	13—14	...	...
213,200	Stk.	Mar. 5	6	6	Hornsey Con. 3½ p.c. ...	91—94	...	...
2,800,000	,,	May 21	15	25	Imperial Continental Cap.	320—340	+15	310—335
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392,000	—	Apl. 2	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	86—89	...	...
675,000	Stk.	May 21	†6	†6	Montevideo, Ltd.	90—100	...	...
2,061,315	,,	Mar. 5	5	5⅛	Newcastle & Gateshead Con.	16/3—16/9[d/f]	...	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	75—77[d]	+1½	...
691,705	,,	Jan. 8	3½	3½	Do. 3½ p.c. Deb. ...	69½—70½[d]	...	...
277,285	,,	May 7	5	5	Do. 5 p.c. Red. Deb.	98—100[d]	...	...
199,940	,,	Mar. 5	7½	7½	North Middlesex 6 p.c. Con.	115—120	...	...
396,160	,,	Feb. 5	5	5	Northampton 5 p.c. max. ...	74—79	...	...
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60,000	5	13 May, '15	—	—	Ottoman	0—½	...	...
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1,736,968	Stk.	Mar. 19	6½	6½	Sheffield Cons.	105—107[e]	...	...
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90,000	10	June 11	‡5	‡5	South African	3⅜—5⅛*	—½	...
6,709,895	Stk.	Feb. 5	5	7½	South Met. Ord.	102⅜—104½	...	102⅜—103⅜
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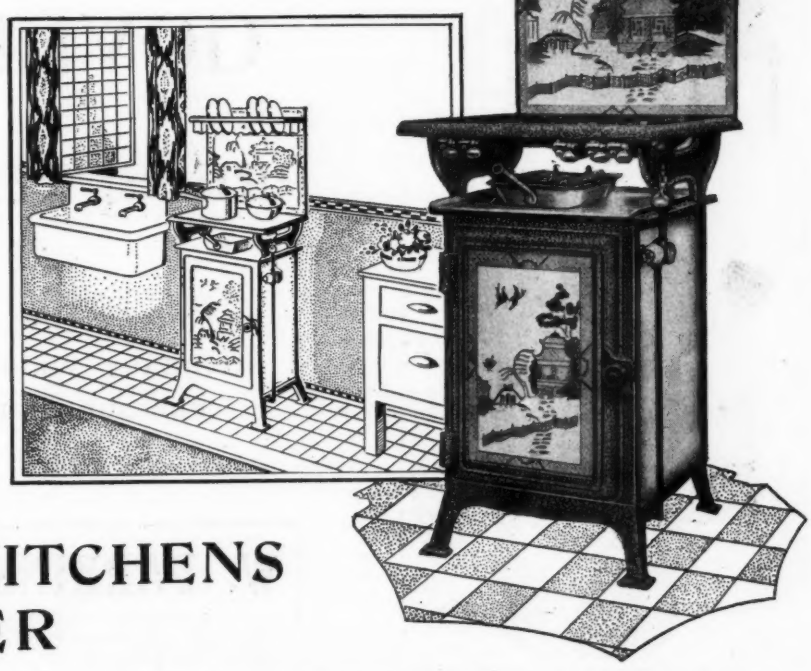

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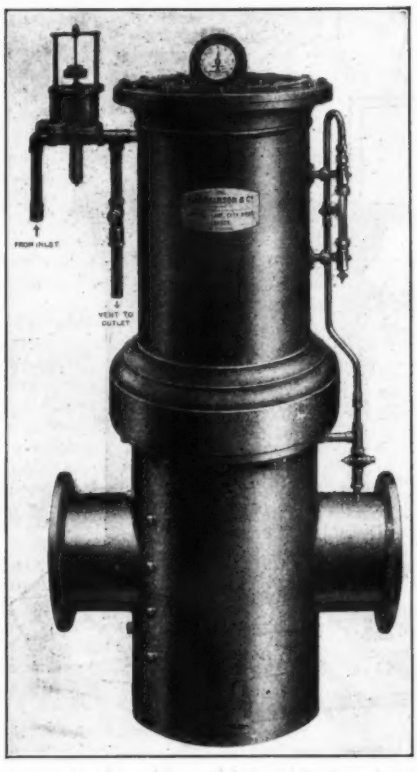

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